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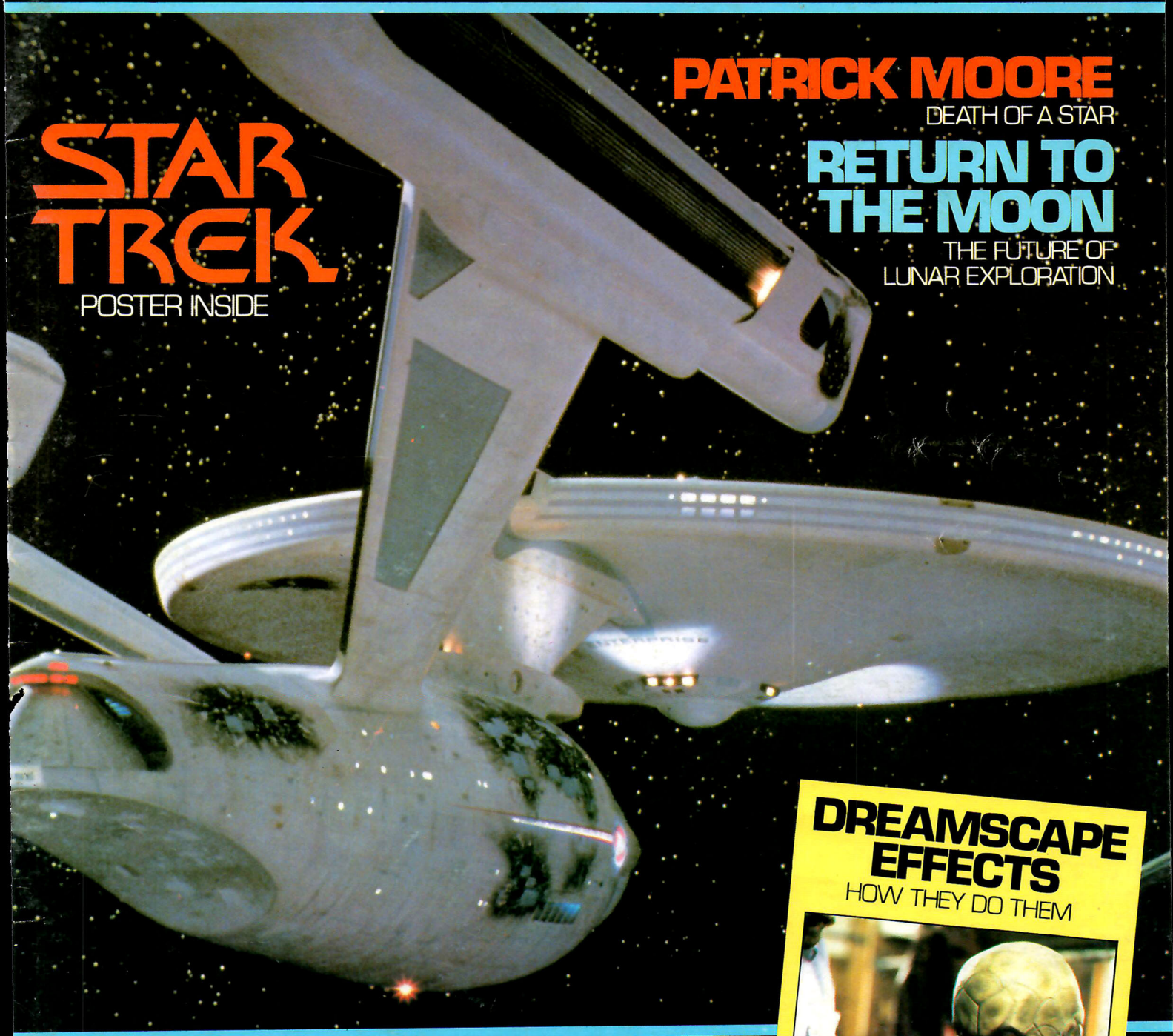

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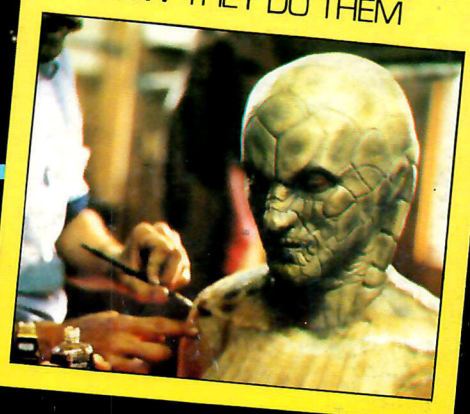

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SPACE VOYAGER

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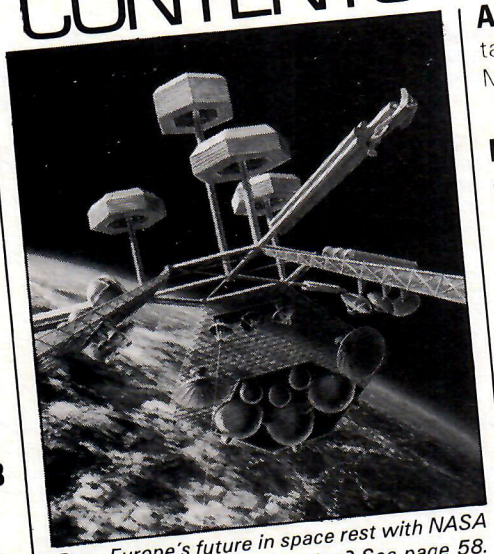

Does Europe's future in space rest with NASA projects like the space station? See page 58. Photo: Lockheed

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We don't have space to tell you all about it here, but be sure to look out for it on September 21st. **Your Model Railway** – simply the best.

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Your MODEL Railway

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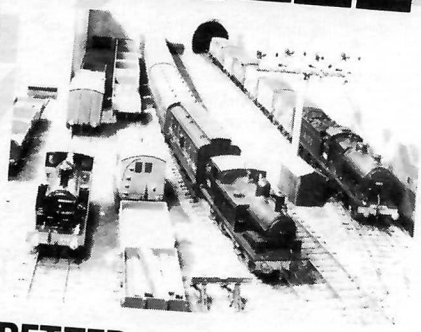
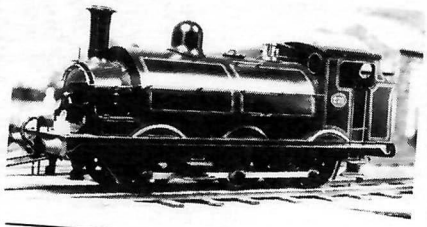


BETTER advice on modelling for the enthusiast with special features for beginners.



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CAPTAIN'S LOG

Captain's Log serves a twofold function this time round. In addition to introducing the October/November issue's contents, it must also serve as my farewell message. My short occupation of the editor's chair comes to an end with this issue. From the December 1984/January 1985 issue your new editor will be Wendy Graham (no relation). If you're a regular reader, you will be familiar with Wendy's work as a contributor.

I have enjoyed editing *Space Voyager* over the past few issues. I've been fortunate enough to work with an excellent Art Editor (Steve Archibald) and his team at Hemel Hempstead, who have been responsible for the high standard of the magazine's appearance. I'm sure they will continue to do a fine job for Wendy.

In many respects, it's much easier to take an existing magazine and shape it than it is to conceive a new idea for a magazine, persuade a publisher to take a chance on it and make it work successfully in the long term. So I must pay tribute to the magazine's co-founders, Ray Rimell and Mat Irvine, who established *Space Voyager* as Britain's premier science fact/fiction magazine.

Space Voyager is an odd creature in the magazine business. It covers a wide range of loosely connected topics, each of which has an extremely enthusiastic following. However, most of those topics don't lend themselves to attracting advertisers, which every magazine must do to survive. None of the agencies or companies engaged in the production or operation of space hardware have anything to sell to *Space Voyager* readers, so they don't advertise.

Feature film distributors do advertise science fiction films occasionally, but *Space Voyager* suffers here somewhat from being a bi-monthly. Distributors and their press agents are reluctant to release photos and information much in advance of the film's release for good commercial reasons, so *Space Voyager* often misses the opportunity to publish a preview (which would normally attract an advertisement from the distributor) to coincide with the film's release. Once the film has been released, the distributor is normally no longer interested in advertising.

Moreover, because the magazine covers a wide range of topics, it's difficult to 'pigeonhole' as a spaceflight magazine, or an astronomy magazine, or an SF magazine, or a modelling magazine, etc, etc. It's all of those things and many more, but not any one of them exclusively. And that makes it a difficult magazine to which to assign a convenient identity for the purposes of selling advertising. So, I must congratulate *Space Voyager*'s advertising manager, Karen Newton, who has worked extremely hard in trying to attract more advertising revenue.

Looking to the future, Wendy Graham has some interesting ideas in the pipeline for *Space Voyager*, so you can expect to see the magazine continue to evolve.

October/November

The cover feature is Randy Lofficier's critical review of the American release of Star Trek III – The Search For Spock. Randy and Jean-Marc Lofficier have been working overtime for this issue. They've also put together a Letter From Hollywood and a report on the trials and tribulations of designing special effects for the American SF film Dreamscape.

A large chunk of the issue is devoted to modelling, with reviews of two Revell History Makers (the Apollo Lunar Spacecraft and Jupiter C rocket), advice on scratch-building and custom-converting standard figure models, and examples of readers' model-making expertise.

Aldo Rabaiotti investigates the global effort to make comprehensive observations and measurements of Halley's Comet as it approaches the Earth. Of course, some chunks of rock actually reach the Earth's surface. Sharon Clark writes about meteorite finds and their significance.

Looking back out to space again, Patrick Moore presents a thumb-nail sketch of the closing stages of a star's life. Closer to home, David Hardy looks forward to the day when we will return to the moon. That takes us to the time when space stations will orbit the Earth and, perhaps, the moon too, and strange vehicles ferry people and supplies between Earth and orbit or from Earth orbit to moon orbit, and finally down to the moon's surface. Shuttle Derivatives reports on the new generation of space vehicles now on the drawing board and based on well tried and tested Space Shuttle components.

The regulars

And of course there are the regulars – news from around the world, your letters in Communications Bank, another batch of book reviews in Read-Out, new Products news and competitions . . . which brings us to the silly-comp.

Silly comp

Uhura is hot and bothered and decidedly angry about something. Phasor at the ready, she squares up to . . . who, or what? Try to come up with an entertaining caption for this photograph by suggesting what Uhura is saying. Send your entry to:

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The winner will be awarded a one year subscription to *Space Voyager*. Good luck!

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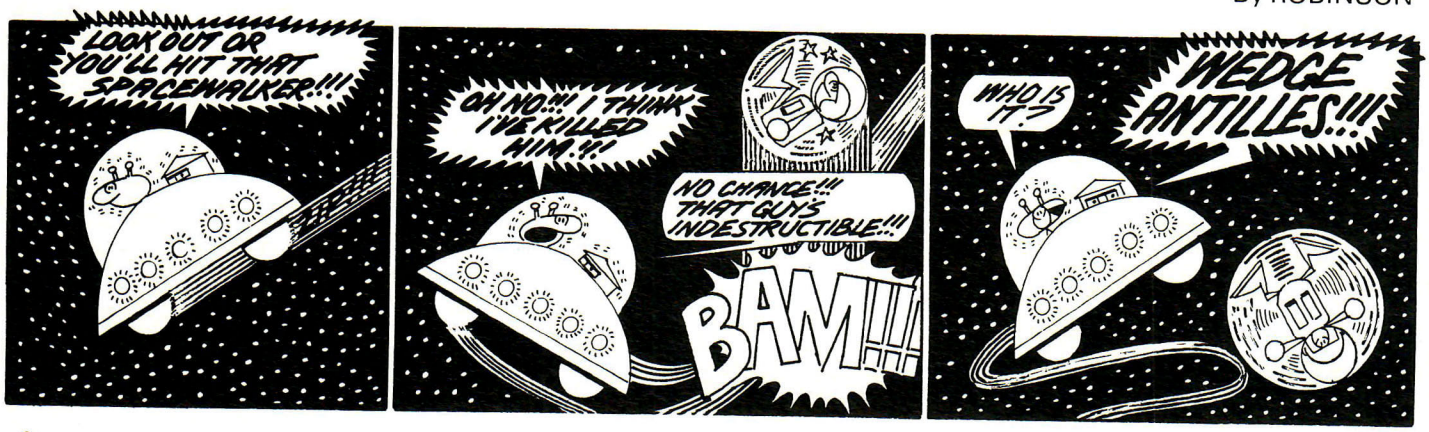
PLUTONIUM PETE

By ROBINSON


LOOK OUT OR YOU'LL HIT THAT SPACEWALKER!!!
OH NO!!! I THINK I'VE KILLED HIM!!!
NO CHANCE!!! THAT GUY'S INDESTRUCTIBLE!!!
BAM!!!
WHO IS IT?
WEDGE ANTILLES!!!

DATA BANK

Cheaper satellites

More efficient and cheaper satellites are the aim of a research fellowship which has been set up at the University of Kent, Canterbury, by British Aerospace.

Fully funded by BAe's Dynamics Group's Space and Communications Division, based at Stevenage, the University will investigate novel techniques in the design of multi-frequency satellite antennae.

At present, to build one satellite able to handle several frequencies means a separate antenna for each frequency, incurring cost and design penalties.

One way round this problem may be in designing an antenna configuration with several sub-reflectors stacked one behind the other. These would have special surfaces which are transparent to all but one frequency band.

The fellowship will investigate the theory of this concept and tackle the practical problems, such as quality of performance control, as well as the physics involved, and BAe will take care of the practical problems.

Space competition

There's still some time left to enter the ITN in Space competition, but you'll have to hurry. ITN and Space Services International are offering a free flight for the winning experiment in a nationwide schools competition.

The object is to come up with the best idea for an experiment to be carried in a small canister in the Space Shuttle Orbiter's payload bay next year. The canister measures only 50.2 cm (19.75 inches) by 35.89 cm (14.13 inches) and no live animals can be used as the tiny container and payload bay environment could not support life. However, insect and plant experiments have proved to be very popular amongst the entries already received.

The experiment will have access to three switches which will be operated by the Shuttle astronauts. One of the switches must be capable of cutting off power to the experiment, which must have its own power supply.

The competition is not open to individuals, only to schools, technical colleges and apprentices in industry. ITN has already sent out over 4500 information packs, but if your science teacher doesn't have one, write for details to Frank Miles, Experiment in Space, ITN, PO Box 4BY, London W1A 4BY. But you'll have to be quick – the closing date for entries is October 15th 1984.

B7 Afterlife published

After several months of rumours amongst *Blake's 7* fans, it has been confirmed that *Blake's 7: Afterlife* is to be published in November by W H Allen in their Target imprint.

News of a new *Blake's 7* story following on from the final episode of the 52-part television series was first leaked at the *Blake's 7* convention Edge-Con in mid-1983. The new story has been written by Tony Attwood (author of *Blake's 7: The Programme Guide,* also published by W H Allen) with help and guidance from the series creator, Terry Nation. The novel starts off just after Avon has killed Blake and the rest of the cast of the series lie dead at his feet.

Tony Attwood is quoted as saying, 'I don't think anyone will be surprised to find Vila survived the shoot out, along with Avon: . . nor that at least one of the other crew members from Avon's ship is still alive'.

The 192-page novel explains why Avon shot Blake and hints at the reason for Avon's increasingly strange behaviour in the episodes before the final shoot-out. In common with the television programmes, the book is said to end with something of a cliff-hanger.

Does this mean that Blake is brought back to life. Not exactly, according to Attwood. 'Blake appears in two different forms, neither of which is Roj Blake the original hero of *Blake's 7,* nor are they clones or ghosts'.

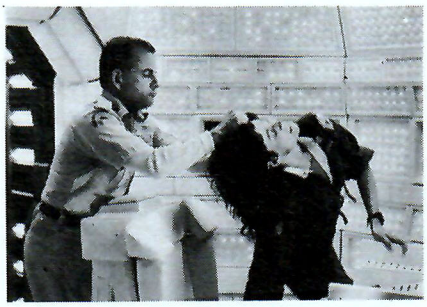
Blake's 7: Afterlife will be available in November, priced at £1.80.

Competition results

The winner of the June/July issue caption competition is S. Halligan of Leighton Buzzard, who wins a year's subscription to *Space Voyager* with this caption for a scene from *Alien:* Ash, *'I told you not to use Superglue on your wig'!*

The winners of the Corgi *Belgariad* and *The Right Stuff* competitions in *Space Voyager* issue no.9 have also been drawn from the editorial hat. Unfortunately there is not sufficient space here to publish the full list of 100-plus competition winners' names. All winners have been contacted by post and should by now have received their prizes.

The words hidden in the wordsquare were, as most of you found: Apollo, Mercury, Glenn, Yeager, NASA, Kennedy, rocket, launch, splashdown and burn. Some entrants pointed



Alien still – Competition results.

out that the names Alan (Shepard) and Gus (Grissom) could also be found, and these were accepted instead of Glenn and Yeager. Also, LEM could be found and offered instead of rocket, and that was accepted.

The answers to the Corgi *Belgariad* quiz were:

1. By what name is the character Belgarath first known to Garion? – Mr Wolf or Old Wolf, the Storyteller.
2. What was the name of the farm where Garion spent his childhood? – Faldor's Farm.
3. What is the connection between Aunt Pol and Belgarath? – Father and daughter.
4. Two of the companions of the quest you are introduced to in Book 1 are Silk and Barak. From which Kingdoms did they come? – Silk was from Drasnia, Barak from Cherek.
5. What is the name of the King of Cherek? – King Anheg.

The three winners of the *Belgariad* book sets, who made the most words from the series title were: Derek Orr of Marsden, South Shields (747), Craig Sanders of Woodley, Stockport (745) and Stephen Herring of Windlesham, Surrey (673). We disputed some of the words offered, but the final result remained unchanged. Congratulations.

CONVENTION CALENDAR
by Marion van der Voort

Oct 6 VILACON 84 Blake's Seven, Southampton. Write Fiona McArthur, 15 Hazel Close, Charlesford, Hants.

Oct 13 COMIC MART London, as Aug 4.

Oct 12-14 MIDCON 84. Star Trek Leicester. Guests: George Takei & Bruce Hyde. Write Terry Elson, 8 Ennerdale Close, Oadby, Leicester LE2 4TN.

Oct 12-14 CONQUEST. Mainly Elfquest. Glasgow. Guests: Richard & Wendy Pini, James White. Write Pat Brown, 104 Pretoria Road, Patchway, Bristol NS12 5PZ.

Oct 19 Hatfield Poly Con. Hatfield, Herts. Write Keith White, PSIFA, c/o Hatfield Polytechnic Students Union, PO Box 109, Hatfield, Herts.

Oct 27-28 GALACTICON 84. Multi Media. London. Write to Eileen Windgrove, 334 Parkside Avenue, Barnehurst, Bexley Heath, Kent.

Nov 3 BIRMINGHAM COMIC Mart. See Sep 15.

Nov 9-11 NOVACON 14. SF. Birmingham. Guest: Robert Holdstock. Write 11 Fox Green Crescent, Acocks Green, Birmingham 27.

Nov 16-18 FOURTH LEONARD NIMOY CONVENTION. For Nimoy the actor. Nottingham. Write Carol Davies, 77 The Ridings, Ealing, London W5 3DP.

Dec 8 COMIC MART. As Aug 4.

Dec 14-16 SANTACON. Media, Leeds. Multi Media. Write Santacon, 84 Ambrose Street, Fulford Road, York YO1 4DR.

NASA NEWS

New Discovery

NASA's latest addition to the Space Shuttle Orbiter fleet, Discovery, was to have blasted off on June 25th. However, launch on that day was delayed following a computer malfunction. The launch was put back to the following day. However, on that day, the countdown appeared to proceed normally until the main engines fired. Before the solid rocket boosters fired and the whole assembly lifted off, the on-board computer system detected an engine fault and shut the main engines down.

Although NASA has not yet revealed the precise reason for the shut-down, revised plans for future flights have been released. The next shuttle flight will carry the payloads intended for both the aborted mission (41-D) and mission 41-F. At time of writing, launch has been set for no earlier than August 24th, but it is still subject to change. The mission, aboard Orbiter Discovery, will retain the designation 41-D. The crew that would have flown mission 41-F have been rescheduled for a later flight.

The combined mission cargo will consist of three communications satellites – the Hughes Leasat (Satellite Business Systems), the AT&T Telstar 3-C, and the OAST-1 collapsible solar array and the McDonnell Douglas electrophoresis system.

NASA has put a brave face on events. Acting Associate Administrator for Spaceflight at NASA headquarters, Washington DC, said, 'The Shuttle program is adaptable enough to meet the needs of our paying customers without risking lives, equipment or payloads . . . The abort we experienced demonstrated clearly that we are able to control the launch process down to the last split seconds; to launch when everything is right and to stop without danger to crew, ship or cargo when something is wrong . . . The ability to integrate payloads demonstrates a flexibility to recover from unexpected delays that is essential to an operational transportation system. We are determined to honour launch commitments to our commercial customers.'

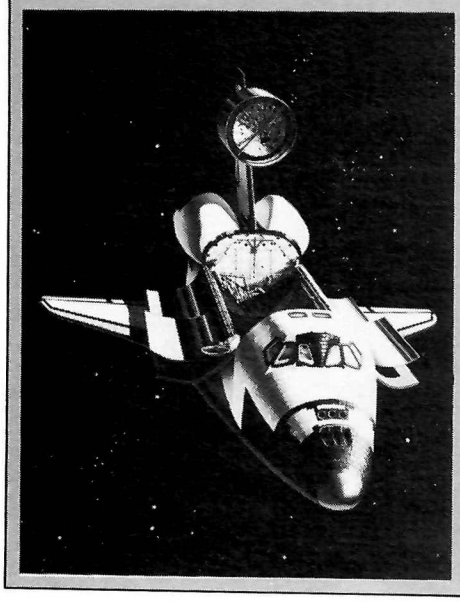
Discovery's first commander will be veteran astronaut, Harry Hartsfield, who served as pilot on the fourth shuttle flight (STS-4) two years ago. He is to be accompanied by pilot Michael Coats and mission specialists Steve Hawley, Richard Mullane, Judy Resnik and Charles Walker. As we reported in the last issue of *Space Voyager*, Walker's presence is being paid for by his employer, McDonnell Douglas Astronautics.

The seven day mission, ending with a landing at Edwards Air Force Base in California, was originally to have included the deployment of a communications satellite and the testing of a solar array. The 32 metre high experimental array may be used to provide additional electrical power for future Orbiters and, possibly, space stations.

The mission also would have featured the first commercial orbital pharmaceutical processing and the first flight of a large Earth-mapping camera that will be used again on future flights. The large format camera has now been rescheduled for a future flight, to make room for another communications satellite. A second Hughes Leasat satellite, scheduled for mission 41-F, will be flown on mission 51-A.

A Hughes Aircraft engineer adjusts part of the communications electronics carried by AT & T's Telstar 3 satellite, to be launched by Shuttle mission 41-D. See 'New Discovery'. **Photo: Hughes Aircraft Company.**

A Shuttle Orbiter launches a Hughes Aircraft HS 393 communications satellite. Mission 41-D's payload will now include three communications satellites, one of them a Hughes Telstar 3. See 'New Discovery'. **Photo: Hughes Aircraft Company.**



Satellite lost

NASA's commercial satellite launch programme has suffered another blow, with the failure to place a $100 million Intelsat V payload in its correct orbit.

This time the villain of the piece was not the Space Shuttle's Payload Assist Module (PAM), responsible for losing two satellites on STS-10. The Intelsat V satellite was launched by a normally reliable Atlas Centaur rocket from Cape Canaveral on June 9th. Shortly after launch, it was found to be not in its correct orbit, but tumbling out of control. This is the fourth incidence in 15 months in which a NASA-launched satellite has failed to achieve its planned orbit.

NASA report that the launcher was not the standard Atlas-Centaur, but a new stretched version carrying more propellants to lift a heavier payload (up to 5100 lb). The first stage appeared to be fuctioning correctly until tracking contact was lost. When the vehicle was again picked up, by the tracking station on Ascension Island, the second stage appeared to be tumbling. The satellite was placed in a 96 by 600 nautical mile orbit. Intelsat subsequently moved it into a 150 by 600 nautical mile orbit.

The satellite was owned by Intelsat, a 108 nation consortium which provides worldwide telecommunications services for 171 user countries through a network of ground stations and geostationary communications satellites positioned over the Atlantic, Pacific and Indian Oceans.

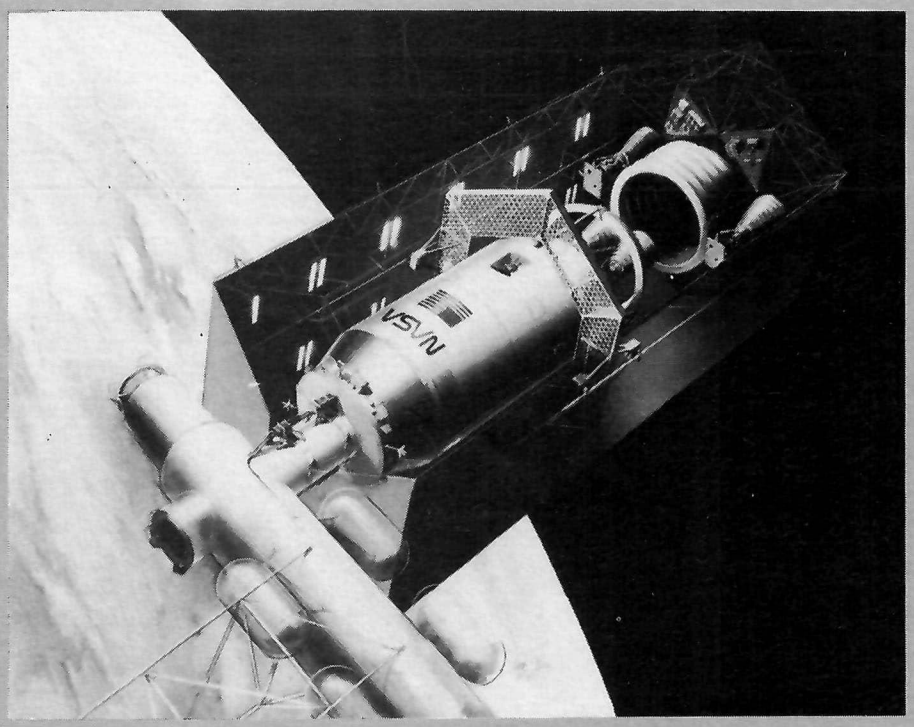
NASA has set up a review board headed by NASA headquarters Chief Engineer, Dr Milton A Silveira, to investigate the incident.

OTV contracts

A space vehicle to move payloads from low Earth orbits to higher earth orbits will be the subject of new study contracts awarded by NASA's Marshall Space Flight Centre in Huntsville, Alabama.

Both Martin Marietta Aerospace (Denver) and Boeing Aerospace (Seattle) have been awarded contracts to perform parallel, but independent, studies for an Orbital Transfer Vehicle (OTV). The cost of each contract, which will run for 15 months, is about $1 million.

The OTV is seen as an unmanned vehicle which, after delivering its payload to the



An artist's impression of an Orbital Transfer Vehicle (OTV) being serviced in the hangar of a space station in low Earth orbit. Boeing Aerospace is conducting concept definition studies for NASA. See 'OTV contracts'. Photo: Boeing Aerospace Company.

desired orbit, would return on its own to either a ground or space base. The ground-based version would be carried to low orbit by the Shuttle. The space-based version would be 'parked' and fuelled at a space station. The ground based OTV could be carried to orbit in an aft cargo carrier configuration of the Shuttle (see 'Shuttle Derivatives' elsewhere in this issue). A space-based OTV could be constructed in orbit, and so made larger than a ground-based OTV which would have to be accommodated in the Shuttle's payload bay or aft cargo compartment.

Crew selection

NASA has announced the flight crew for Space Shuttle flight 51-H and mission specialists for flight 61-E

The new mission codes, replacing the old 'STS' numbers, comprises year (1985=5), launch site (Kennedy Space Centre=1), and the number of the flight in that year (the seventh flight in a year=G).

Veteran astronaut, Vance Brand, will command mission 51-H, scheduled for launch in November 1985. It is due to use the newest Orbiter, Atlantis. Brand commanded the first operational Shuttle flight in November 1982 (STS-5) and mission 41-B, the first to use the Manned Manoeuvring Unit (MMU) in February 1984.

The 51-H crew will also include Michael J Smith (pilot), Robert C Springer, Dr Owen K Garriott and ESA astronaut, Dr Claude Nicollier (mission specialists) and Dr Michael L Lampton and Dr Byron K Lichtenberg (payload specialists).

The payload on this mission will be Earth Observation Mission-1 (EOM-1), a reflight of nine Spacelab-1 experiments. The cargo pay will contain a short Spacelab habitable module and a pallet of experimental hardware.

Launch of mission 61-E is set for March 1986, wtih a crew of six, using the Orbiter Columbia. Mission specialists will be Dr Robert Parker, David Leestma and Dr Jeffrey Hoffman. The cargo will be Intelsat VI-1, a large Intelsat communications satellite, and Astro-1, an astronomy package designed to view Halley's comet.

Extra crew

Paul D Scully-Power, 40, a civilian oceanographer with the US Navy, has been added to the 41-G Space Shuttle crew that is scheduled to fly in October 1984.

He joins Robert L Crippen (commander), Jon A McBride (pilot), mission specialists Dr Kathryn D Sullivan, Dr Sally K Ride and David D Leestma, and payload specialist Dr Marc D Garneau of Canada. Scully-Power, who has played a major role in NASA's oceanographic program for more than three years, will make observations of more than three quarters of the Earth's oceans from orbit. His addition makes the 41-G crew the largest to date – seven members.

The major purposes of the mission are the deployment of the Earth Radiation Budget Satellite (ERBS), operation of the Shuttle Radar Laboratory and operation of the Large Format Camera. The radar laboratory is an upgraded reflight of the successful Shuttle Imaging Radar (SIR-A) that flew on STS-2.

Consistent with NASA policy, the data gathered by Mr Scully-Power will be made available to the public for scientific and educational purposes.

New Shuttle-nauts

NASA has announced the names of 17 astronaut candidates selected for the Space Shuttle program. Seven are pilot astronaut candidates and 10 are mission specialist astronaut candidates.

However, selection at this stage does not mean that they are certain to join Shuttle crews. The newly selected group will report to the Johnson Space Centre in Houston this summer to begin a year's training and evaluation. If successful, they will then begin training assignments leading to a further selection process for Space Shuttle flight crews.

As you can imagine, there are lots more people eager to join the Shuttle program than NASA can hope to accommodate at this time. On this occasion, they received 4934 applications and of those, 128 were interviewed and given medical examinations at the Johnson Space Centre. But of those, only 17 were finally selected for evaluation leading, maybe, to selection for flight crew.

Spacelab crews

NASA has announced the payload specialists selected to fly on the Spacelab 2 and 3 missions. Both are career scientists, not test pilots.

Drs Lodewijk van den Berg of EG & G Corporation, California, and Taylor G Wang of the Jet Propulsion Laboratory will be payload specialists on Spacelab 3, scheduled for launch in January 1985.

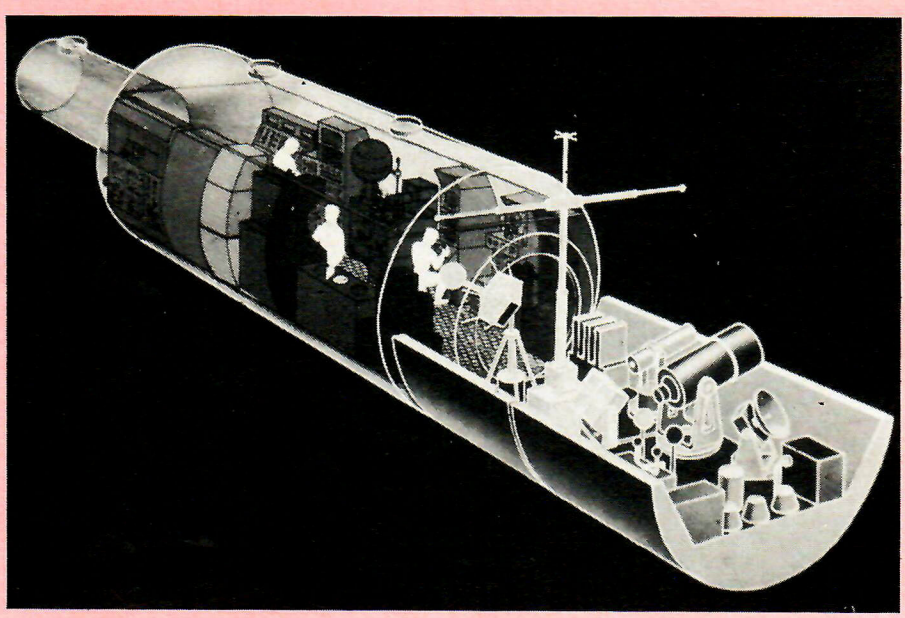
Drs Loren W Acton of Lockheed Palo Alto Research Laboratory and John-David Bartoe of Washington's Naval Research Laboratory are named as payload specialists on the Spacelab 2 mission, which, because of development delays, will take off after Spacelab 3, in April 1985.

Halley watchers

NASA has selected a team of scientists to observe Halley's Comet in 1986 using a Space Shuttle-based astronomy observatory called Astro.

Astro consists of three specially designed ultra-violet telescopes and two wide-field cameras that will be carried as a Spacelab payload in the Shuttle's cargo bay. It will fly on a series of missions to study stars and galaxies in ultraviolet light.

NASA NEWS



Spacelab – Europe's manned orbiting laboratory. See 'Spacelab crews'. Photo: ESA.

The scientists selected to make the observations are Dr Michael A'Hearn (University of Maryland), Drs John Brandt, Bertram Donn and Malcolm Niedner (Goddard Space Centre), Dr Barry Lutz (Lowell Observatory), Dr Chet Opal (University of Texas), Dr Robert C O'Dell (Rice University, Houston) and Dr Susan Wycoff (Arizona State University). In addition, a scientist will represent each of the three ultraviolet telescope teams – Dr Paul Feldman (Johns Hopkins University, Baltimore), Dr Arthur Code (University of Wisconsin) and Theodore Stecher (Goddard Space Centre).

Halley's Comet will also be observed by probes from the European Space Agency (ESA), Japan and the Soviet Union.

More Solar systems

Results from the Infra-Red Astronomical Satellite, IRAS, indicate that more than 40 nearby stars show excess infra-red emission, consistent with the presence of solid material orbiting the stars.

Last year, IRAS discovered that the stars Vega and Fromalhaut were each orbited by solid material, probably in the form of small grains. The latest results on other nearby stars, which have yet to be analysed in detail, suggests that it may be common for stars to be orbited by solid material, which may evolve into planets.

IRAS science team member, Dr Hartmut H Aumann of NASA's Jet Propulsion Laboratory, emphasised that IRAS has not detected any individual planets around these stars. He also explained that much more work was necessary to fully understand what the satellite had observed. The excess infra-red emission might possibly be due to mass lost from the star. These possibilities were ruled out in the case of Vega.

IRAS was launched into a polar orbit by NASA on January 25th, 1983, for its 10-month mission. It observed about 20 000 galaxies. An unexpectedly high percentage of these are merging, colliding or otherwise interacting with one another. Up to 25% of the most luminous galaxies observed by IRAS were found to be merging or interacting, compared with a figure of less than 5% of all visually identified galaxies.

Navigation award

An award for navigation that dates back to the 18th century has been given by the American Philosophical Society to an engineer at the Jet Propulsion Laboratory in Pasadena, California.

Dr Frank Jordan, manager of JPL's Navigation Systems Division, recived the society's Magellanic Premium award for his leadership of the group that successfully navigated Voyager 1 and 2 to encounters with Jupiter in 1979 and Saturn in 1980 and 1981.

The award was established in 1786 by a gift from one John Hyacinth de Magellan of London, a friend of Benjamin Franklin. It's awarded from time to time to the author of the best discovery or most useful invention relating to navigation, astronomy or natural philosophy.

The award is something of a coup for JPL, all the more remarkable when you learn that it is the Laboratory's third. In 1966, JPL won it for the first time for its spacecraft explorations of the moon and Venus. Engineers Muller and Sjogren shared it in 1970 for their discovery of mass concentrations (MASCONS) in the moon's ringed basins – vital to the safe landing of the Apollo astronauts on the moon's surface.

Surprising comet

Pioneer Venue Orbiter has made a surprising observation of the comet Encke. The comet is losing water at approximately three times the rate expected by scientists considering its distance from the Sun.

In April, scientists at NASA's Ames Research Centre turned the spacecraft up to look at the comet instead of the Venusian cloud tops. It is thought that as the comet is probably not a uniformly spherical and homogeneous mixture of dust, rock and water ice, a portion of its surface with a high water ice content may be vapourising rapidly to produce the anomalous results.

The spacecraft launched in 1978 to make a detailed scientific study of Venus, was tipped up by commanding it to fire tiny thrusters. It was tipped back again to resume its Venus study by the same method. The Orbiter spins about five times a minute, so the thruster firing times and durations have to be made at the appropriate moment in each spin to achieve the desired change in orientation. For the Encke observation, the spin axis was shifted by 200 firings or pulses of the thrusters, each half a second long. The measurements of Encke's water loss were made by the spacecraft's ultra-violet spectrometer.

Researchers analysing data from the International Ultra-violet Explorer (IUE) have confirmed Pioneer's observations.

Comet Encke was first observed in 1786 by French astronomer, Pierre Mechain. Why isn't it called Comet Mechain? The comet was, in fact, named after the German astronomer, Johann F Encke, who calculated the comet's orbit in 1818.

Encke was the first astronomer to work on a comet with a measurably aberrant orbit – its period (the time taken to travel once round the Sun) was getting shorter. Since then scientists have discovered that as the comet's water ice boils off, the resultant jet reaction can change the comet's orbital path slightly.

ESA NEWS

Exosat's birthday

The European X-ray Observatory Satellite (Exosat) has celebrated its first birthday in orbit. Launched from Vandenberg Air Force Base in California in 1983, it has provided astronomers with exciting new information in the field of X-ray astronomy.

The spacecraft is three-axis stabilised and has a payload of four X-ray instruments – two low energy imaging telescopes (LEITs), a large area gas-filled Medium Energy (ME) experiment and a Gas Scintillation Proportional Counter (GSPC). All the experiments 'look' in the same direction, which is also aligned with a star tracker. The star tracker provides a reference for the spacecraft's attitude control system.

This orbital observatory is operated from the European Space Operations Centre (ESOC) in Darmstadt, West Germany. It's available for use by astronomers all over the world. In spite of partial failures of detectors in the imaging telescopes, scientific results have been described as 'extremely exciting'.

In particular, the observations of stars in our own galaxy has been especially rewarding. Such exotic objects as neutron stars and black holes (dead stars less than 20 km in diameter but heavier than our own Sun!) have provided detailed information on the physics involved in objects where extreme gravitation conditions exist.

The study of X-ray emission from stars involves the investigation of some of the most highly energetic phenomenon in the universe – gas at temperatures of over 10 million degrees, for example. Exosat's task is to probe the behaviour of such highly energetic objects. It has provided detailed information on the orbital periods of a number of binary star systems, rotation rates of neutron stars, the remnants of supernova explosions and the energy output of galaxies, quasars and clusters of galaxies.

Exosat's orbit is perturbed (the orbital path is changed) by the gravitational influence of the Sun and Moon, and by the equatorially bulging shape of the Earth. The effect is that without any intervention, Exosat would re-enter the Earth's atmosphere almost three years after launch. Its on-board orbit control system could be used to boost it higher, extending its orbital life by more than a year. The attitude control system is used to point Exosat at selected objects. About 1000 attitude manoeuvres have been performed using propane thrusters, enabling Exosat to observe more than 700 X-ray sources.

Exosat's transmissions are received by a dedicated ground station at Villafranca, Spain. As it isn't in a geostationary orbit, it can't be 'seen' by the ground station all the time. Generally, loss of signal coincides with times when the spacecraft's altitude falls below 70 000 km, when the payload is not operational due to passage through the Earth's radiation belts.

Giotto launch contract

ESA and Arianspace have signed a contract for the launch of the ESA scientific spacecraft Giotto.

Giotto launch contract signed.

Giotto will be launched by an Ariane 1 launcher in July 1985. Every precaution will be taken in this specific case to avoid delay, since this would mean that Giotto could not keep its encounter with Halley's comet on 13 March 1986.

During its cruise, Giotto will be controlled by the European Space Operations Centre (ESOC) in Darmstadt, West Germany. For detailed information on the Giotto mission, see 'Encounter With Halley's Comet', elsewhere in this issue.

SOVIET NEWS

Woman spacewalks

The soviet union added to its catalogue of space firsts when Svetlana Savitskaya became the first woman to make a spacewalk. On her second visit to the Salyut-7 orbiting space station, she made a three and a half hour spacewalk during which she took part in a welding experiment.

Savitskaya, blasted off from the Baikonur Cosmodrome with cosmonauts Dzhanibekov and Bolk in a Soyuz T-12 spacecraft on July 17th. They joined cosmonauts Kizim, Solovyov and Atkov, who have been aloft since February 9th, probably making an attempt on the mission duration record of 210 days.

Dzhanibekov is making his fourth flight. He's been closely involved with the development of procedures for handling and operating space stations. His first flight in 1978 was the first to visit Salyut-6 and investigate the stability of the station in orbit with two Soyuz spacecraft docked with it. He also took part in two internationally crewed missions – Soviet-Mongolian to Salyut-6 in 1981 and Soviet-French to Salyut-7 in 1982.

Svetlana Savitskaya made her first spaceflight in August 1982, nearly 19 years after the first woman cosmonaut, Valentina Tereshkova, made her historic flight. On her 1982 flight, Savitskaya was a cosmonaut researcher. On her current flight, Igor Volk is the researcher and Savitskaya is flight engineer. She was welcomed aboard Salyut-7 with a bunch of flowers (ox-eye daisies) and is reported to have been 'allotted a most convenient place in the space compartment'.

Before she joined the cosmonaut training programme, she was an experienced test pilot, having flown 20 aircraft types and set 18 world air records. In 1970 she was the world aerobatics champion.

Salyut's Progress

The unmanned Progress 22 cargo ship sent to re-supply Salyut-7 has now finished its mission successfully. It was launched on May 28th and docked with the space station two days later. The supply ship, carrying mail, food, new equipment and fresh photographic supplies, was unloaded and the station's joint propulsion system was refuelled.

The cargo ship's engine was used to correct the station's orbit. Used and no longer necessary equipment was then loaded into the empty freighter.

On July 15th, Progress was undocked and powered up remotely. As a result of engine braking, it descended into the thicker layers of the Earth's atmosphere and, as the Novosti press release says, 'ceased to exist'. The Progress series of craft – Progress 20 (April) Progress 21 (beginning of May) and Progress 22 – constitute a well-organised production line fleet of semi-automatic supply craft.

DYING STARS

STARS JUST SEEM TO GO ON AND ON BUT THEY DO HAVE A BEGINNING AND AN END PATRICK MOORE REVEALS THE FINAL STAGES OF A STAR'S LIFE

What keeps the Sun shining? This is a question which baffled astronomers for many years. By now we have found out the answer – or believe we have; the essential clues were discovered just before the war, mainly by Hans Bethe in America and Carl von Weizsäcker in Germany. And in probing the mysteries of the Sun, we are also finding out about other stars – because, after all, the Sun is nothing but a normal star.

So let us begin at the beginning, and try to see how a solar-type star is born, how it evolves, and how it will die. In the process we must also look at different types of stars, those which are much more massive and powerful than our Sun as well as those which are lightweight and feebler, because the initial mass of a star is the dominant factor upon its whole life-story.

There is no doubt that a star begins its career inside a nebula. A nebular is a mass of 'dust' and gas in space; many are within the range of small telescopes, and some, such as the Great Nebula in the Sword of Orion, are visible with the naked eye. The material is very rarefied (many millions of times less dense than the air you and I are breathing), but the nebula is very large, and there is plenty of star-forming matter available. Chance condensations occur, and as soon as they have become sufficiently massive gravity takes over, the condensation shrinks, and stars begin to form, usually (not always) in clusters. This is happening inside the Orion Nebula, and we have actually watched new stars begin to shine.

At first the star is unstable, and irregular in its output of energy; stars of this type are known as T Tauri variables, because T Tauri, in the constellation of the Bull, was the first member of the class to be identified. The Sun must have passed through a T Tauri stage, and during this phase of its career it sent out a powerful 'wind' of electrified particles. It was also at this time that the planets, including the Earth, were formed, and this gives us a vital clue as to the time-sale. Various lines of investigation agree in saying that the Earth is about 4700 million years old. This must therefore be rather less than the age of the Sun as a star, and if we say that the Sun is around 5000 million years old we are certainly not very far wrong. (This is very different from former ideas. Up to the work of Bethe and von Weizäcker, it had been suggested that the age of the Sun might be millions of millions of years.)

Going nuclear

As the Sun continued to shrink, its internal temperature rose and finally reached a value of around 10 000 000 degrees Centigrade. This was the moment when nuclear reactions began, and the Sun set out upon the main part of its luminous career.

Hydrogen is the lightest of the elements and is also the most plentiful – in fact, the number of hydrogen atoms in the universe far exceeds those of all the other elements put together. The Sun, naturally, contains a great deal of hydrogen. When the core temperature reached 10 000 000 degrees, the nuclei of hydrogen atoms started to band together to make up nuclei of the second lightest element, helium. It takes four hydrogen nuclei to form one nucleus of helium. In the process, a little energy is set free and a little mass is lost. It is this energy which keeps the Sun radiating. The mass-loss amounts to 4 000 000 tons per second! The Sun 'weighs' much less now than it did when you started reading this article. But have no fear; there is plenty of material left (the volume of the Sun is well over a million times that of the Earth) and the supply of hydrogen 'fuel' will last for at least 5000 million years before anything dramatic happens. This means that the Sun is only half-way through the really stable period of its existence.

Before going on with the story, I must turn back to the work of two astronomers, Ejnar Hertzsprung and Henry Norris Russell, more than half a century ago. They looked at large numbers of stars and discovered a very curious thing. Red stars come in two types: very large, powerful giants and very feeble dwarfs. Red stars of intermediate luminosity do not exist and the giant-and-dwarf division is very marked indeed. It is also obvious, though less pronounced, for the orange and yellow stars, but not for the white or bluish-white stars. Hertzsprung and Russell produced a chart, in which the stars were plotted according to their luminosities and their surface temperatures, which range from below 3000 degrees C for the cool red stars up to well over 50 000 degrees for the hottest types. These 'H-R Diagrams' are of tremendous importance. Most of the stars lie along a band stretching from the upper left (luminous, very hot stars) down to the lower right (cool, feeble red stars) and this band is known as the Main Sequence. The Sun is a typical Main Sequence star, with a surface temperature of almost 6000 degrees.

Stellar evolution?

Did the H-R Diagrams represent an evolutionary sequence? Hertzsprung and Russell believed so, but they were right only in a sense. The Sun is not gradually cooling down, as they thought. On the original picture the Sun would simply fade and become dim and red, finally losing all its light and heat. We now know that this idea is much too straightforward. Oddly enough the Sun is not cooling down at the present time. In the far future it will actually heat up!

It is already about 30% more luminous than it used to be early in its career. (There is a strong possibility that this increase in power had a very drastic effect upon the inner planets. Venus is about the same size and mass as the earth. But is more than 20 000 000 miles closer to the Sun. According to the latest theories, Venus developed an Earth-type atmosphere and even oceans, but as the Sun became more and more powerful, the oceans of Venus evaporated, the surface temperature rocketed, and the planet became a furnace-like inferno, so that any life which had gained a foothold there was remorselessly wiped out. We are fortuante that the Earth was just clear of the danger-zone.) But when its supply of available hydrogen runs low, 5000 million years hence, the Sun will have to rearrange itself. Well before that the luminosity will have grown considerably, because there will be fewer particles to maintain the outward pressure from the Sun's core and keep it from shrinking; remember, four hydrogen nuclei go to make one helium nucleus. The only way to counteract this is to increase the core temperature. The Earth will become a much warmer place than it is today, with the climate of Iceland becoming much the same as that of modern California.

However, this is only the beginning. When the core has evolved so that it is made up chiefly of helium, the hydrogen will start to react in a shell all round the core itself. The Sun's surface layers will expand, and though the surface temperature will drop below 4500 degrees, th total luminosity will increase threefold. The Earth's temperature will rise by a full 100 degrees – enough to evaporate the oceans and to spell the end of our type of life.

Seas of lava

Now things happen quickly. The core temperature soars to a fantastic 100 000 000 degrees as the Sun leaves the Main Sequence and becomes a red giant, the luminosity increases to 500 times the present value, and the Earth's surface is now nothing more than a sea of molten lava. Then, suddenly, the helium becomes so heated that it begins to react. The 'helium flash' is almost instantaneous; the core expands explosively and the whole make-up of the Sun is altered.

There follows a period of 'helium burning' and then a whole series of instabilities and readjustments as the Sun draws its 'fuel' from other elements such as carbon and oxygen. But finally, the outer layers billow out and are blown completely away. The result is what we call a planetary nebula – a bad name, since the object is not strictly a nebula and is certainly not a planet. It is made up of the core of the old star surrounded by an expanding shell of gas which gradually spreads out and dissipates. Planetary nebulae are beautiful – the most famous of them, the Ring Nebula in the constellation of Lyra, is visible with a small telescope – but they represent late stages in a star's evolution.

The Sun, then, will go through the planetary nebula stage, which will not last for many millions of years before the outer layers are finally lost. There remains the core, which is still very hot, with a surface temperature of 10 000 degrees and a mass about half that of our present Sun. But the make-up is very different. Nuclear power is exhausted and the shattered remnants of the atoms are packed closely together with almost no wasted space. Matter of this kind is termed 'degenerate' and it is so dense that it can prevent further quick shrinking. The Sun will have become a White Dwarf. (Note that a White Dwarf is not merely a small, normal white star; it is senile and has been described as a stellar bankrupt.)

Heavyweight dwarf

A White Dwarf is a curious object. The density is truly amazing – a thimbleful of White Dwarf material would weight tons. The star's 'atmosphere' will be only about 300 feet deep. Many White Dwarfs are known, the best example being the faint companion of the brilliant Sirius, and there is no reason to doubt that they are very common in our Galaxy and others. But what happens to them in the end?

Well – we can only give a logical answer based on the fact that there are no energy reserves left. For thousands of millions of years the Dwarf will go on shining weakly, but in the end it must lose all its energy and will end up as a cold, dead globe or Black Dwarf, probably still orbited by the ghosts of its remaining planets. Since Black Dwarfs give out no radiation at all, they are not detectable and we cannot even be sure that the universe is yet old enough for any Black Dwarfs to have evolved, but sooner or later it must happen and there can be little doubt that this will be the final end of the Sun.

As I have said, the Sun is a very ordinary star, of average size and mass. Now let us look at other kinds of star and see how they will run through their life-histories.

First, consider stars of very low mass, say less than a tenth that of the Sun. They condense out of nebulae in the usual way, but never become hot enough for nuclear reactions to begin inside them, so that they simply turn into dim red dwarfs, fading away until they have lost all their energy. It may be said that a star of this type has failed its Common Entrance examination!

Next, let us turn to a star with an initial mass more than 1.4 times that of the Sun. Here, everything happens at an accelerated pace and the star takes only a few thousand years to join the Main Sequence. Things proceed as with the lower-mass stars, only more quickly, and heavier and heavier elements are built up from the lighter ones; there is a stage when the star is rather like an onion, with different regions round the core producing different reactions. Finally, however, iron nuclei are created and all the reactions stop, because iron cannot be forced into building up more complex elements, no matter how high the temperature. There is a sudden implosion (the opposite of an explosion) and the outer shells of the star are heated to incredible temperatures. A violent shock-wave disrupts the star, which literally blows itself to pieces in what is termed a supernova outburst. Much of the star's material is hurled away into space, while the end product of the original star becomes a tiny, unbelievably dense body made up of neutrons.

Free of charge?

As most people know, protons carry a unit positive charge of electricity, while an electron carries a unit negative charge. When a proton and an electron are forced together, as they are in a supernova outburst, the two charges cancel each other out to form a neutron, with no charge at all. The supernova remnant is a neutron star, perhaps only five or six miles in diameter, but with a density of around 100 million million times that of water. A pin's head of neutron star material would weigh more than the liner *Queen Elizabeth 2*.

A neutron star has a very strong magnetic field, and it is spinning round rapidly. The magnetic 'beams' swing round in the manner of a lighthouse and every time the Earth passes through a beam we receive a pulse of radiation – which is why neutron stars are often called pulsars. Only a few have been identified with optical objects. The classic case is that in the Crab Nebula, a gas-patch in Taurus which is the remnant of a brilliant supernova seen in the year 1054 and which for a time became brilliant enough to be seen with the naked eye in broad daylight. The Crab neutron star spins round 30 times a second, so that we receive 30 pulses, and it has been identified with a very dim, flashing object with the same period.

Pulsars seem to be gradually slowing down as they lose their energy, so that eventually they will cease to pulse – and they too will end up as cold, dead globes, though much smaller and much more massive than the White Dwarfs.

Unchartered courses

Finally, what of stars which are more massive still – too massive, in fact, to explode as supernovae? Here we do not pretend to be certain of the course of events, but apparently the collapse cannot be halted once it has started. Gravitation takes over, and the old star goes on shrinking and shrinking, becoming denser and denser. This means that the escape velocity will go up.

Most people know what is meant by escape velocity. In the case of the Earth it is seven miles per second, so that an object thrown outward at seven miles per second will never return; the Earth' gravity will not be strong enough to drag it back. The smaller and denser a body, the higher the escape velocity. With our massive, collapsing star, there comes a time when the escape velocity has risen to 186 000 mils per second. This is the speed of light. This means that light cannot escape from the old star – and if light cannot do so, then certainly nothing else can, because light is the fastest thing in the universe. The collapsed star surrounds itself with an area which is, to all intents and purposes, cut off from its surroundings. Material can go into it, but nothing – not even light – can ever come out. It has become a Black Hole.

Obviously we cannot see Black Holes, but we can detect them because of their effects upon objects which we can see. There is, for instance, Cygnus X-1, at a distance of around 6500 light-years. Here we have a massive star which is associated with an invisible body which has at least 14 times the mass of the Sun. (We know this because the two are in orbit round their common centre of gravity.) There is every reason to think that the companion is a Black Hole which is pulling material away from its more normal partner. Just before the material disappears into the Black Hole it is intensely heated and gives off X-rays – hence the name Cygnus X-1.

The boundary of a Black Hole is known as the event horizon. What happens inside the event horizon is a total mystery. All the laws of ordinary science break down and we have to confess our total ignorance. There have been suggestions that with a rotating Black Hole, at least, it might be possible to go in it and emerge either in another part of the universe, or in a completely different universe. It has also been mooted that the old collapsed star might crush itself out of existence altogether. I admit to being decidedly sceptical about exotic ideas of this sort, but one never knows.

Solar forecast

At any rate, of one thing we may be certain: our Sun is not massive enough to form a Black Hole, or even to explode as a supernova. When it uses up its 'fuel' it will pass through the red giant stage, eject its outer layers and become a planetary nebula for a brief period before settling to a long senility as a White Dwarf and eventual death. We will not be here to witness the death of the Sun, but if humanity survives for thousands of millions of years, we may well learn enough to save ourselves in some way or other. This remains to be seen, but let us end the story on an optimistic note. The Sun is doomed; but its end need not necessarily mean the end of mankind.

DREAMSCAPE

RANDY AND JEAN-MARC LOFFICIER REVEAL THE TRADE SECRETS OF THE SPECIAL EFFECTS TEAM THAT PRODUCED THE SPECTACULAR MAKE-UP EFFECTS FEATURED IN THE AMERICAN SF MOVIE, DREAMSCAPE

What would happen if someone invaded another person's dreams? This is the subject of *Dreamscape*, the story of a young man who can enter dreams at will, and who uses his power to rescue the President of the United States from an assassination attempt. This theme, which has rarely been handled by Hollywood, is brought to the screen by producer Bruce Cohn-Curtis of Zupnik-Curtis Enterprises. Curtis has, in the past, produced *The Seduction*, starring Morgan Fairchild, and *Hell Night*, starring Linda Blair of *The Exorcist* fame.

'I had never produced a science fiction movie, or a film with special effects, and I thought that would be a challenge,' said Curtis. 'I loved the concept of *Dreamscape* when the script was brought to me by director Joe Ruben. I thought the idea of being able to go into someone's dreams and participate in them was great. It's really like an adventure story. In a way, it's close to *Fantastic Voyage*.'

'David Loughery, Chuck Russell, Joe Ruben and I all reworked the original script. We retained the original concept, but developed some of the characters and added more dreams to it. We added dreams that we thought would be easier for audiences to relate to. The story now is more like science fact than science fiction. It is possible that it could happen in, perhaps, 50 years because I know that there are dream research centres today. In fact, Joe and Dennis Quaid visited one of those at UCLA. We also hired a psychic as a technical advisor on the film.'

'We do different things so that you know you're in a dream. Just before you go to sleep you see spots before your eyes, we have that. We have what we call *dream tunnels*. We go inside four different dreams, and each time we take the audience through the tunnels. We also shoot each dream differently.'

In bringing *Dreamscape* to the screen, Curtis assembled a cast which is led by Dennis Quaid, who portrays the film's hero, Alex Gardner. Quaid was recently seen in *The Right Stuff* and *Jaws 3-D*. 'Quaid was always my first choice,' says Curtis. 'We toyed around with some other people, but we came back to him. We thought he had all the qualities that were right for the lead.'

The rest of the casting, according to Curtis, 'just sort of evolved.' Max Von Sydow, for example, portrays Dr Novotny, a scientist who heads an experimental dream laboratory. 'I never knew that we would end up with Max Von Sydow,' comments Curtis. 'I think it was a wonderful choice, and it just happened by accident. His agent read the script and asked us if we'd be interested in him playing the role!' Von Sydow played Ming the Merciless in *Flash Gordon* and starred in a variety of genre pictures such as *The Exorcist, Deathwatch, Strange Brew* and the upcoming *Dune*.

Eddie Albert, who was in *Escape to Witch Mountain, Airport 79* and *The Devil's Rain*, portrays the President of the United States. 'Albert had been in our minds for some time for the part of Blair, our villain,' says Curtis, 'but when he came in for a meeting, I realized that he should play the President. Then Christopher Plummer's name came up, and he ended up playing Blair!' Plummer, who was in *Star Crash* and *Murder by Decree*, plays the head of a covert US intelligence agency who will go to any extremes to protect the interests of the country.

Female lead

As to the female lead, she is Kate Capshaw 'who is Indiana Jones's companion in *Indiana Jones and the Temple of Doom*. Completing the cast is David Patrick Kelly, who plays a villainous psychic. Kelly was in *48 Hrs.* and *Young Warriors*.

According to producer Curtis, the shoot went very well, but the picture was delayed in post-production by complicated special effects. 'If I ever do another science fiction or special effects picture, I would do it differently,' says Curtis. 'I've learned a great deal from *Dreamscape*. You really have to be on top of the effects. It's not at all like dealing with actors, where you have control of the situation and, once the film is finished, you cut it and that's it. With this, you finish the picture, you cut it, and you're still waiting and waiting.

'One of the problems I had with the picture from the beginning, was that we weren't as prepared as we should have been. Because of that, it has taken a little longer on the post-production side. We had about eight months, working on the script plus two months of preparation on the special effects, which wasn't enough time.

'We started the picture and left the special effects until the end. That way, we figured that they could be prepared while we were shooting. If I had it to do over, what I would have done would be to have the prosthetics made, shot them, tested them and made sure that they were functioning properly before the movie was even started.'

Dream make-up

To make the film's dream sequences as realistic as possible, Curtis and his associate producer, Chuck Russell, called upon the talents of Craig Reardon and Pete Kuran. Reardon is famous for his special effects make-ups of *Funhouse, Altered States, Poltergeist, E.T.* and *Twilight Zone*. Kuran started his career in the animation rotoscope department of the first *Star Wars* film. He then worked on *Battlestar Galactica, The Empire Strikes Back, The Howling, Dragonslayer, Conan, The Thing, Star Trek II, Something Wicked This Way Comes*, and *Return of the Jedi*.

Kuran supervised a lot of the blue screen work required for the dream sequences. 'We worked on the elaborate trolley sequence which kicks off the last dream. There's the President and Dennis Quaid riding inside a trolley, travelling past the destroyed landscape of Washington DC. David Patrick Kelly comes in at that point, trying to assassinate the President.

'In another part of the sequence they go into a subway car, and there are mutant people who come after them. There, we used some three dimensional stop motion animation. Then, there are a number of sequences where you see the full body snakeman. That's all stop motion with Craig Reardon basically handling all the close ups of the mechanical effects.'

Reardon created all the prosthetics for the film, including a horrific looking snakeman who haunts the dreamland. 'Chuck first mentioned the snakeman, and said that they would like to have something a little different from recent films,' remembers Reardon. 'I suggested a three dimensional, replacement-animation transformation of one shape directly into another, very different shape, which is something that has never been done before. Chuck was extremely enthused about doing that, and I was hired.'

Dreamscape is the longest project Reardon has worked on. 'I've been on it for about nine months now, but a good third of that has been on this snakeman transformation, which has not progressed quickly and has been a trial and error process. I've never tackled anything like it before, and it's turned out to be extremely intricate and time consuming. Before I'm done I will have sculpted and painted approximately

Who'd be a commuter? The same daily grind, on the same train with the same old faces! This is the fantasy age of the train, Dreamscape-style.

The first stages in the transformation of actor to snakeman.

Acid indigestion can strike at any time! Dreamscape's nightmare continues.

40 separate heads. We had to do two snakemen, which involved making one enormous costume, with two different articulated heads, each representing a different snakeman.

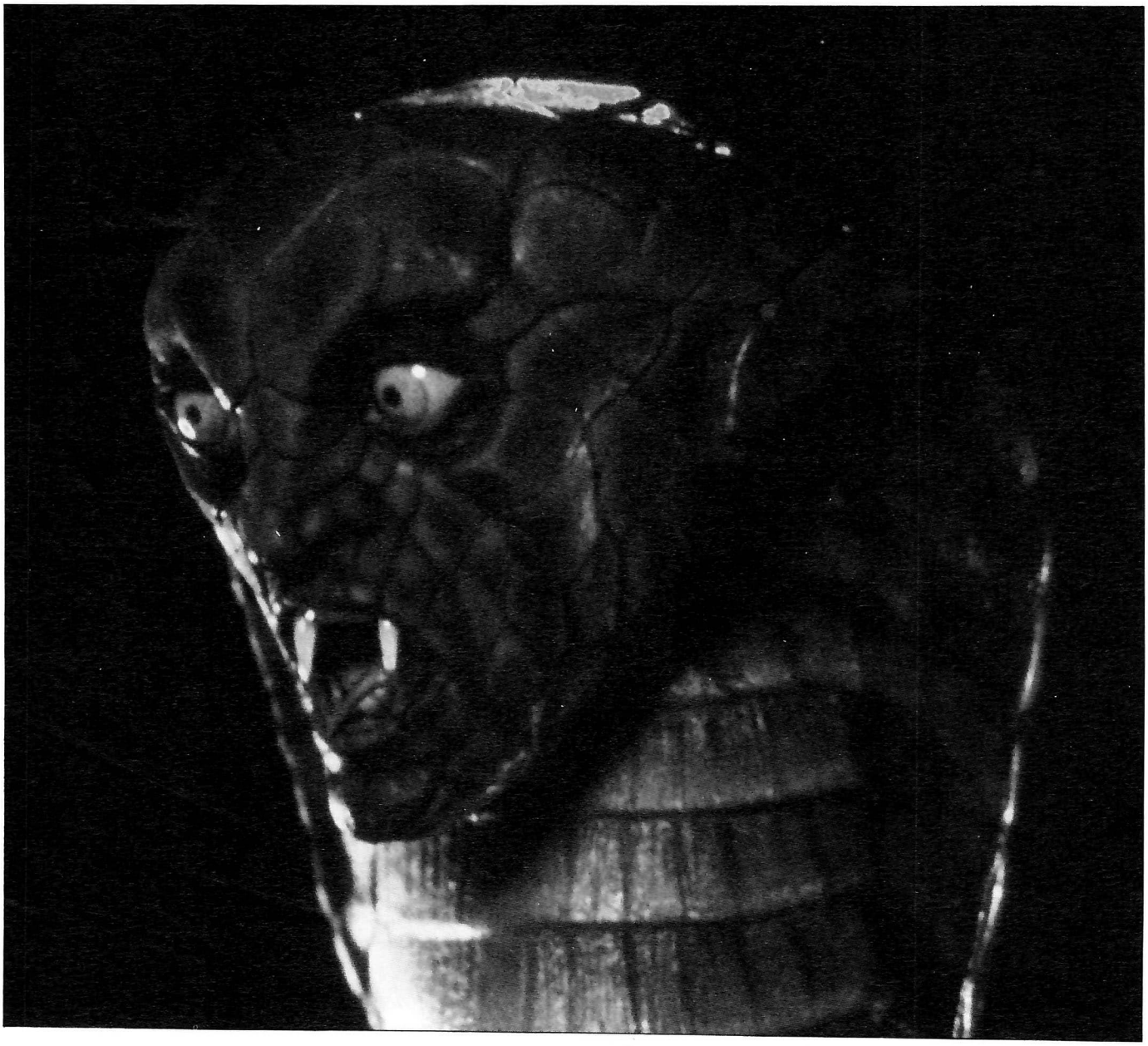
'I started with a portrait sculpture of David Kelly, and altered it very slightly, one head at a time, until I got it so far along that I felt I could take a mould off of that. Then, I would generate the next 12 or so heads from that. When that one had progressed far enough, I would take another mould. That way, I didn't have to completely duplicate everything from scratch from one head to the next. I've just altered the cast and resculpted it at each stage. That's where the little anomalies are introduced. Not only are you changing the shape in ways that are necessary, but you're also getting little anomalies as to placement of the head, its tilt, etc. The heads were made from a special plastiline clay, and painted with a base coat. But as the features change, the colours also change, gradually and subtly. That's the difficult thing to smooth out so that there isn't a lot of chatter when all the frames go whizzing by in the final product. I'm going to work closely with Peter Kuran when the thing is photographed. I hope that that way, we'll be able to smooth out some of these jittery effects.'

Waisted snakeman

Reardon recalls other problems having to do more with the selection of the snakeman designs that the intrinsic technical difficulties of the scenes. 'We made an entire seven foot tall snakeman. Ironically, they never photographed it from the waist down, except for about a half-second when it bursts through a window. It had always been stated that for certain shots they would use an animated model, and they wound up using it a lot more than they intended, because they didn't feel that the suit would read believably. My view is that a rubber suit is not necessarily anathema. It's all according to how it's shot, how the performer uses it, etc. I think we could have gotten more dynamism out of the entire suit. It was very good-looking and had every potential. But this is just one of those impasses that sometimes happen.'

'At one time, the snakeman's head looked pretty much like a straightforward snake. I had wanted to make it look like a cobra's head. But, then they came in and said it wasn't enough of a snake*man*, so I had to rotate the eyes from the side of the head, which is what a cobra has, to more binocular, like a man. In my opinion, I don't consider this to be an improvement.

'Also, at the very end of the picture, Quaid turns into the snakeman as well. They decided at the beginning that we would begin to see the transformation overwhelming him, then there would be a cutaway, and when we went back we would see Alex's version of the snake monster. Which is how it was executed. When



One actor's head and many sculpted model heads later, the transformation is complete – a fully fledged snakeman.

they saw it they were displeased. They didn't feel it had enough dramatic impact. So, they thought they would rather see Alex tear his face down the middle, like a paper bag, and have the monster emerge from there. They went to Greg Cannom, because I was too occupied with this animation, and he executed that alternate version. I was pleased with what he did, and seeing it discarded was just another, incomprehensive disappointment for me.'

Reardon details the other effects he did for *Dreamscape*. 'We had a place where Tommy Ray (Kelly) transforms and has knives spring from his fingers. He uses these to tear out someone's heart, which sits beating in his fingers. We made a prosthetic hand for this scene, and an artificial heart. Then, in another scene, Kelly has to look like one of the mutants. This we did with an appliance make-up. At the end of the film, Kelly appears in a form halfway between himself and that of the snakeman. For this, we had to do a very elaborate make-up which also concealed a device to depict his death by impalement. Bruce Kasson engineered all of the mechanics for me on the film, and did an excellent job, time and again.'

Optical replica

'At that point in the story, Alex (Quaid) also turns into a replica of Kelly's father, and that's being handled by Pete Kuran, through optical effects. Quaid is also bitten by the snakeman at one point, and causes his wound to heal through mind power, since this is in the dream state. I designed a way to do that without a dissolve effect, all in one take. Unfortunately, now, they decided to redo it with a more conventional optical/fade effect.

'It's been a long, hard climb, and it's been good of Bruce Cohn-Curtis and the other production people to wait so patiently. It's been frustrating for Bruce that things are taking so long, but this animation effect is a special case. Everything else, of course, was on more familiar ground and was delivered on schedule.'

Bruce Cohn-Curtis does not disagree. 'The special effects people are artists. You have to give them their head and allow them the time, because they're perfectionists. Sometimes, at the eleventh hour, things don't work and it's back to the drawing board. You have to have a great deal of leeway *and* a great deal of patience.'

He even shares some of Reardon's disappointment about the difficulties encountered in the preparation of the special effects. The example he gives is that of nuclear-ravaged dogs which haunt the President's nightmares. 'Poor Craig Reardon spent ages working on costumes for these dogs. We spent weeks testing them and getting them to look right, and just before shooting, they still didn't work. At the last minute, we came up with the simplest thing, which was to shave the dogs and put a little paint on them. It will look fantastic.'

But on the other hand . . .

Reardon sees matters in a somewhat different light. 'As far as the dogs were concerned, we were given to understand that the dogs of the originally hired trainers would tolerate wearing the costumes. We then decided to make these extremely grotesque costumes that would show dogs with their rib cages exposed, their faces warped into ghastly parodies of dog faces, the bodies singed and burned with the fur missing, huge blisters and sores everywhere, etc. I hired Michiko Tagawa, who is a very fine artist, very deliberate and painstaking. She made these two dog costumes, which fit perfectly and looked great. But, to make a long story short, the dogs would not tolerate the costumes when they went for their fittings. The trainers began to waffle about the subject, saying that the dogs wouldn't wear the costumes, and finally saying, "Well, what do you expect from them when they're wearing these stupid suits!"

A Actor patiently suffers the painstaking attentions of the special effects make-up artist.

'By that stage, much expense had been put into the construction of the suits, and I was furious. But, it was a no-win situation. We filmed some stuff with the dog suits, but these trainers got to the point where they had to use a different breed of dog to do certain tricks, instead of the doberman pinchers which had been precisely fit for the suits. For one scene, they brought in a Rottweiler, which had a head that was twice as wide, and a big squat body! They jammed the suit on the dog, which looked like a running pile of laundry on film! That was a complete fiasco.

'Finally, they hired another trainer, who had worked on *Cujo*. He brought dogs which he actually shaved in wild erratic patterns, right down to the skin. Then, glop, fake blood and stuff was put on those. We didn't have too much creative input into that. One of our make-up guys helped put the stuff on the dogs. But, believe me, the suits that Michiko had prepared were ten times more frightening. They were marvellous. But, no one will ever see them.

'I felt that some of the potential that was inherent in the script was not realised. I know that directors, and everybody else on a set are placed under a great deal of pressure, having to get certain material done within certain budgetary considerations, but I feel that they should delay when necessary to create these intricate and impressive effects, and make a sequence that will remain in the audience's memory and bring people in. Yet, in spite of my own personal misgivings, I think that the lay audience will come in and be impressed all the same.'

Curtis sums up in a similar fashion. 'The challenge of *Dreamscape* is what attracted me. I feel that I've met that challenge, and I hope that when audiences see the picture they'll agree we've met it successfully. It's not overly heavy on the special effects. It has a lot of humour in it. It's not one of those films where you say, 'It has terrific special effects but a lousy story!' I tried to make an intelligent, entertaining story along with special effects, so they all blend together for an entertaining 100 minutes at the movies.'

RETURN TO

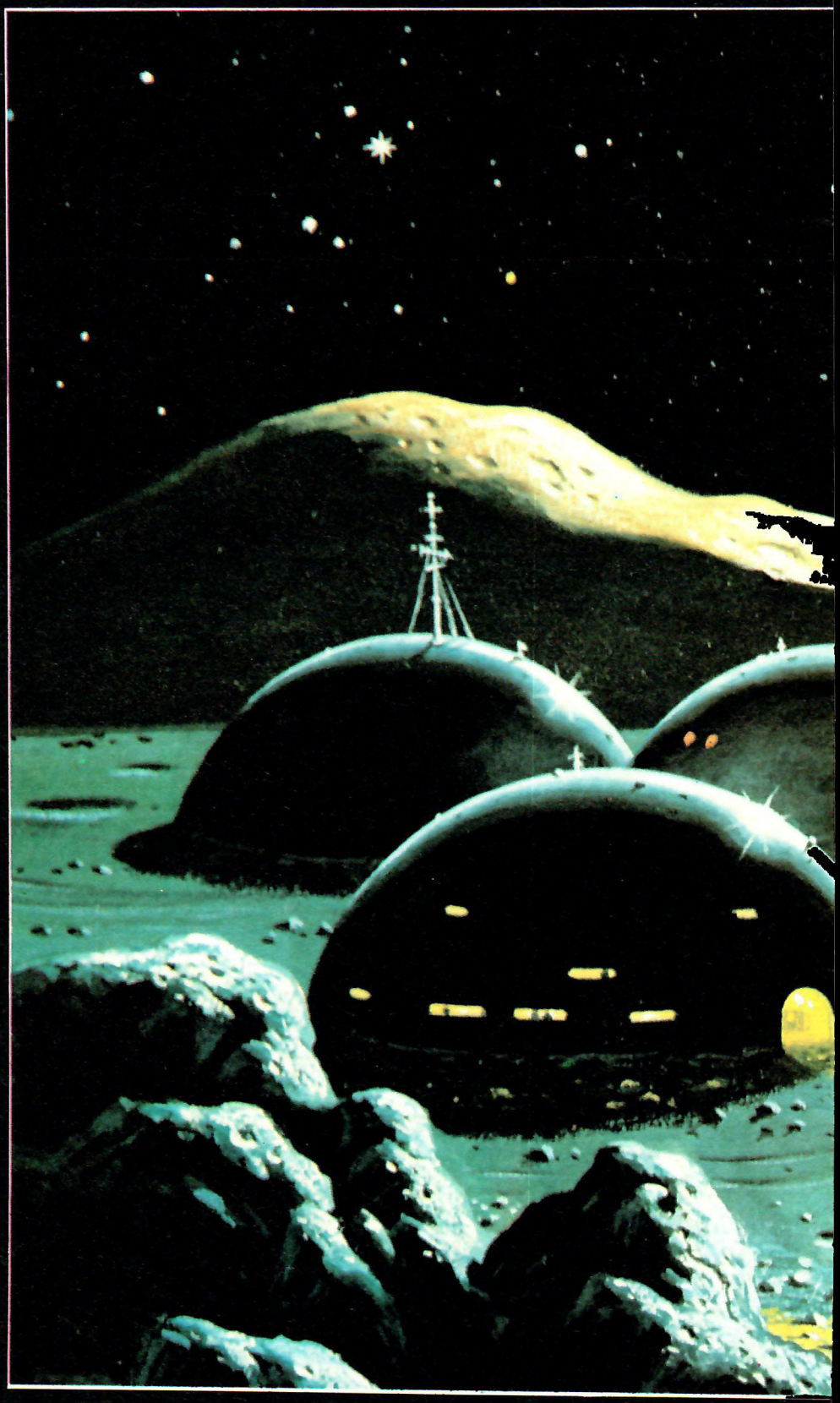
DAVID HARDY LOOKS FORWARD TO THE DAY WHEN WE WILL RETURN TO OUR NEAREST WORLDLY NEIGHBOUR IN SPACE. PAINTINGS AND TEXT BY DAVID HARDY

In my article on the manned exploration of Mars (*Space Voyager* No. 9), the illustrations featured a proposal utilising NASA's projected Orbital Transfer Vehicle (OTV), which should come into operation during the 1990's. The OTV could also be the key to Man's return to the Moon.

The schemes of Wernher von Bruan, the British Interplanetary Society and other visionaries, from the 1950s, envisaged space travel developing one way: first, an orbiting space station (which would gradually grow and 'evolve'), serviced by winged ferry or shuttle-craft; then the construction in the same orbit of vehicles capable of orbiting and then landing on the Moon and Mars and eventually the other planets or their satellites. In later versions a 'space-tug' would be used as an intermediate vehicle between Earth-orbit and lunar orbit.

As we now know, it didn't work out that way. For political rather than scientific reasons, after a few unmanned probes both the USSR and the USA, American men set foot upon the Moon between 1969 and 1972 without a single space station being placed in orbit. The unmanned probes and the equipment left dotted around the lunar landscape serve as monuments to a technological dead-end. The Apollo programme was axed when finances were diverted to more 'important' causes like armaments before humans could examine the really interesting regions of our neighbour in space: the insides of mighty craters, the poles, or 'farside'.

Let's not put down the achievements of Apollo, which were many. Apart from the technological advances and well-publicised spin-off (eg today's micro-processors), many scientific questions were answered. But many more remain. Does water exist on the Moon, perhaps as ice in the perpetually shadowed craters of the polar regions, or below the surface? What are the 'hot spots' detected from orbit? – do they indicate a still-active



Lunar Base at sunrise. A medium-sized lunar base, with multi-storey domes housing living quarters, laboratories, etc. The Sun is rising on the mountains in the background, but the crescent Earth still illuminates the scene.
© David Hardy.

THE MOON

interior? Are there valuable minerals on the Moon, ready to be used by future colonies?

Lunar samples

Between the Apollo landers and the Soviet Lunokhod robot samplers, we have about 380 kg of lunar rocks and soil on Earth. As a result, we now know that the Moon is 4.6 billion years old and is composed of the same basic materials as are fund on Earth, but distributed differently. These facts alone enable us to deduce much about the origins of our Earth, the Sun and Solar Systems, and by extrapolation the other stars and their possible planets. On our own, dynamic world, the record of hundreds of millions of years of evolution has been erased by the activity of its molten interior and the external activity of its erosive oceans and atmosphere. The lack of atmosphere on the Moon gave rise to minerals not found on Earth.

Lunar rocks contain no water and no organic materials, in contrast to terrestrial rocks. There are two basic types: the light-coloured, rough and older rocks of the lunar highlands, often of a type known as breccias, contain fragments of other rocks, due mainly to meteoritic impacts over the eons. Then there are the darker, smoother and younger rocks from the plains or maria (seas). Moon-rock contains at least three minerals formed only in the absence of oxygen and water, such as armalcolite, an oxide of iron and titanium named after Armstrong, Aldrin and Collins of Apollo 11 fame.

The highland rocks are rich in feldspar, a whitish silicate of calcium and aluminium, but some contain greater proportions of pyroxene or olivine – silicates of iron and magnesium, while others contain a lot more potassium (chemical symbol K), rare-earth elements (REE) and phosphorus (P), earning them the acronym 'KREEP'. The lowland rocks, on the other hand, contain much more pyroxene and olivine, plus iron and titanium oxides like ilmenite. They are basically a type of basalt and originated when the Moon's great basins were flooded with molten rock from the interior. A typical sample of Moon-rock might contain more than 40% (by weight) of oxygen, 20% silicon, 12% aluminium, 6% titanium, 4% iron and 3% magnesium – but as I have said, these proportions vary. However, this abundance of metallic minerals, as well as oxygen, bodes well for the time when we can set up ore-processing and air-generating plants on the Moon. Even the silicon is valuable: apart from the obvious micro-chip it will be possible to construct solar panels for power on site, while articles made of ceramics and glass (including glass-wool) can be processed from Moon-soil, or 'regolith' as it is more correctly called.

Earth II

Today, many scientists see the Moon not just as a site for further valuable research, but as a sort of 'Earth II' – a permanent colony, in our own back-yard as astronomical distances go, and a new source of mineral wealth to replenish our own rapidly-depleting resources.

The Space Shuttle belongs to a different generation of spacecraft than Apollo, though obviously its designers drew heavily upon the experience of the Apollo series. We could – and many would still say should – have had a type of shuttlecraft first, then a space station. The USA had Skylab in 1973. The USSR launched its first Salyut in 1971, and has paid much more attention to orbital bases, right up to the present day. But these are mere tin cans compared with future 'islands in the sky', as Arthur C Clarke called them. Earlier this year President Reagan announced approval for a Space Operations Centre (SOC), which is the first real step in this direction, although it will undoubtedly start out quite modestly, with perhaps a six-man crew.

Once the SOC is established, followed by the OTV, NASA will have the capability to deliver large payloads to a geosynchronous orbit – that is, one at which a spacecraft remains fixed over one spot on Earth's surface, as communication satellites do today and Arthur Clarke proposed in 1945 – and return to the SOC. Two NASA scientists, Wendell Mendell and Michael Duke of the Johnson Space Centre, Houston, pointed out in 1983 that the OTV also offers an even more momentous prospect.

If one can reach a Clarke orbit, one can reach the Moon for about the same expenditure of energy. Wendell and Duke started a campaign, enlisting the aid of scientists and engineers to ensure that politicians do not miss this opportunity of a new direction in which to lead the USA. Another Houston engineer, Hugh Davis, proposes that oxygen could be obtained from lunar ilmenite to provide propellant for the OTV and other vehicles. This is one way in which a lunar base could become economically self-sufficient, since deliveries of liquid oxygen from the Moon would allow more room for other payloads from Earth. The expense of Apollo would at last be seen to be justified...

In 1974 the British Interplanetary Society opened up a discussion on the industrial potential of the Moon. Amongst the proposals put forward was one that an electromagnetic launcher or 'mass-driver', solar powered, could be set up alongside a lunar base to launch raw materials economically into space, to be processed at a space station in Earth-orbit under conditions of zero-gravity and high vacuum. Following this up, Dr Bob Parkinson wrote in the BIS *Space-flight* in 1977 that a permanent lunar colony with a population of about 2000 people should be quite feasible by the early 21st century. He drew an analogy with the occupation of Antarctica, but stressed that a greater degree of self-sufficiency would be required.

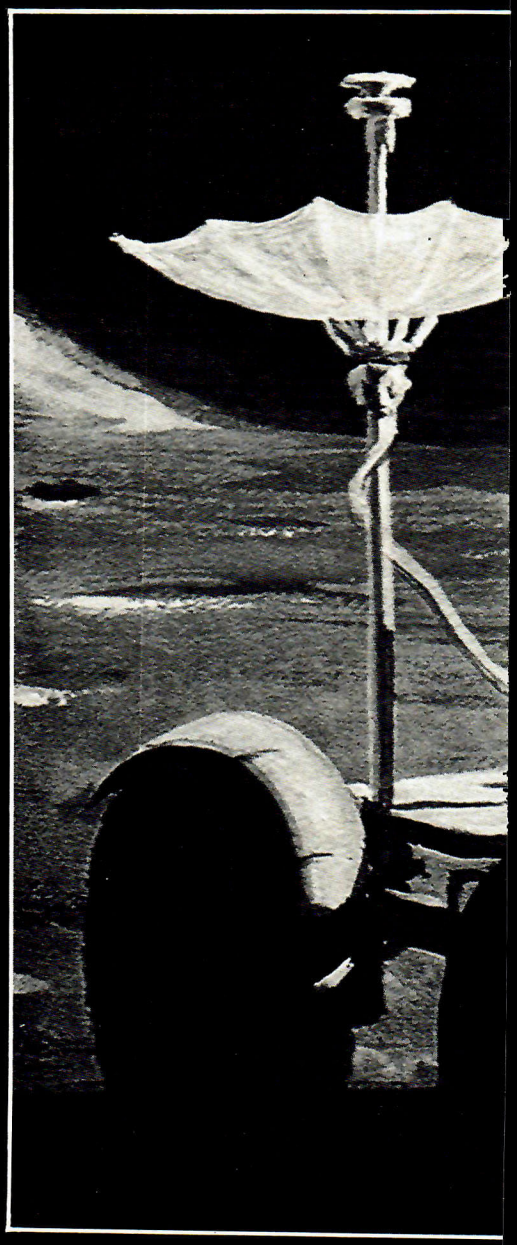
NASA's Deputy Director, Hans Mark, has drawn similar parallels, and remarked that permanent bases were not set up there until over 30 years after Amundsen arrived at the South Pole in 1911. He feels, optimistically, that a lunar base early in the 21st century, three decades after the first Apollo landing, would be right on target

Lunar Skylab

Parkinson agrees with other researchers that the first step back to the Moon would be the placing in lunar orbit of a small manned satellite – the equivalent of a lunar Skylab. This would carry out surveys of possible landing sites and interesting localities for future exploration, the location of resources, and so forth. With the shelving of NASA's space-tug and nuclear stage, he suggested that the chemical-fueled Centaur stage provides an almost ideal expendable vehicle to deliver payloads into lunar orbit after launch by the Space Shuttle.

Apollo was forced to adopt a near-equatorial orbit because of its landing sites, but the most useful orbit for mapping the entire globe would be a polar one. An unmanned Polar Orbiting Lunar Observatory (POLO) is amongst Europe's plans for space, and would act as a useful preliminary step.

So probably the first settlers will travel to the SOC by Shuttle, from there to the lunar space station by some form of space-tug, then make their descent to the surface in a lander. The first base may consist of empty cylindrical fuel-tanks, soft-landed by liquid-fuel motors, as was proposed in a million-dollar NASA study entitled *Outlook for Space* in 1976. More probably it will resemble nothing more than a group of quonset huts equipped with airlocks.



The first use of the Lunar Rover was during the Apollo 15 mission in 1971, as shown here at 'Hadley Base'. When men return to the Moon, more advanced versions of the Rover, with greatly extended range, will be used. © David Hardy.

From these, advanced Lunar Rovers with a range of 200-300 miles will make 9-12 day-long sorties into the surrounding terrain, prospecting for minerals and objects of scientific interest while also seeking out the best sites for a more permanent base (though probably this will merely grow from the initial cluster of modules).

Many studies have suggested covering a surface base with lunar soil to shield it from micrometeorites, cosmic rays, solar flares and extremes of temperature (it is a good insulator). Taking this even further, Dr D J Sheppard of the BIS advocates tunnelling beneath the surface (shades of H G Wells' *The First Men in the Moon*). He points out that the granitic lunar highlands are structurally ideal for excavating tunnels and caverns, though the basaltic rocks of the maria are not totally unsuitable.

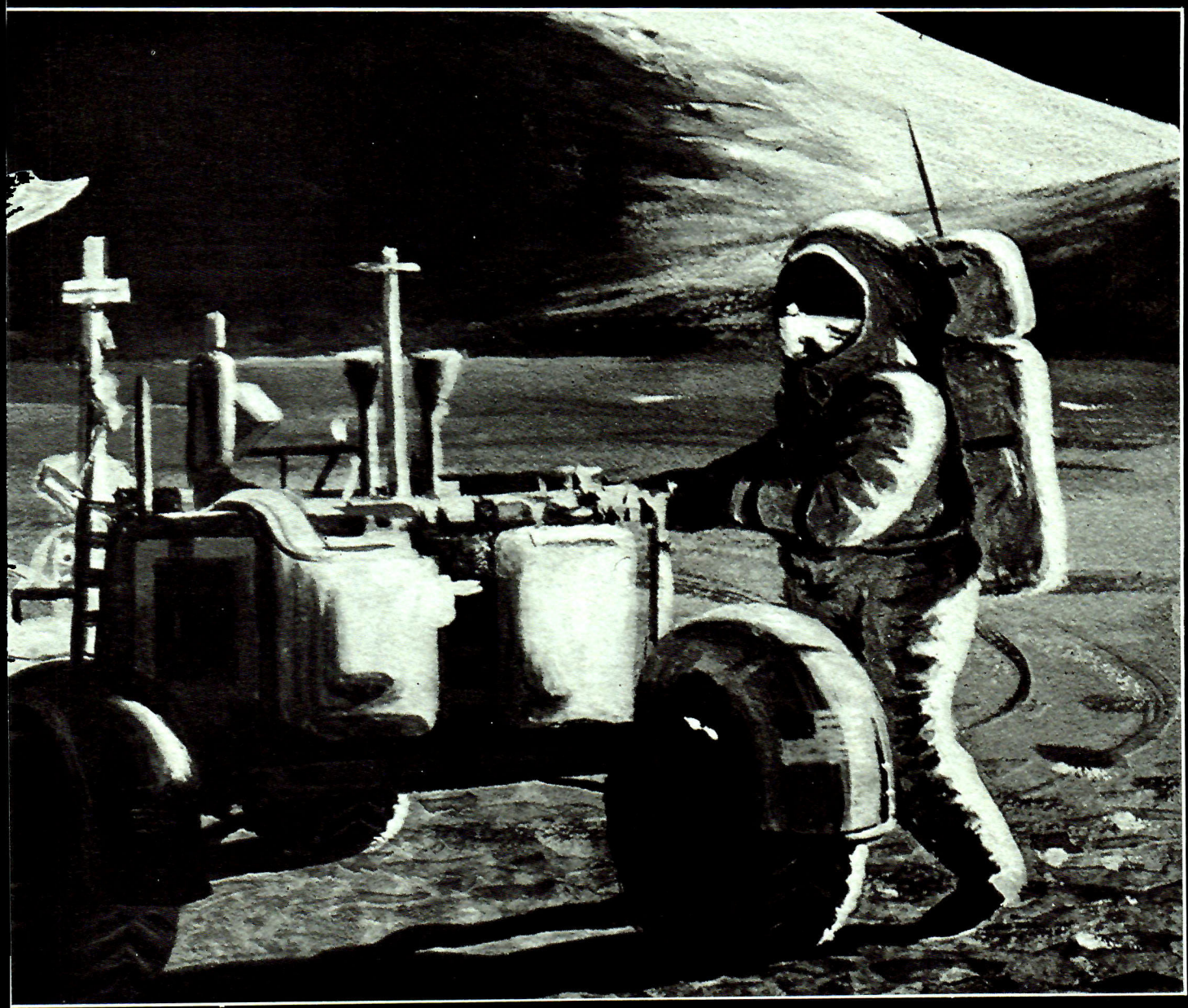
Sheppard calculated the amount of room available for underground colonies, and came up with a somewhat mind-boggling answer. Allowing for lunar gravity, which is only one-sixth of Earth's, he assumes a maximum depth of 14 miles as being equivalent to the deepest mines on Earth. If our descendants decided to honeycomb only 1% of the volume of rock this provides, a total floor area of 1360 miles at normal room height would be useable. This is 24 times Earth's land area and equal to 2100 *million* large L-5 type orbital colonies!

Tunnel vision

This is a somewhat extreme example, to say the least, but there are several factors in favour of underground bases. For instance, any type or scale of tunneling likely to be required has almost certainly received adequate testing and proving here on Earth. And its cost is likely to be as little as one-fiftieth that of surface constructions. Once a well-designed tunnel is completed it should not leak (air or any liquids such as water which have to be stored), nor will it need supports or lining (except for aesthetic reasons), and it will last virtually for ever (natural limestone caves on Earth survive for tens of thousands of years). Sunlight could be ducted in from the surface, where solar panels would provide power. The Moon's internal heat could also be utilised. And if, as seems possible, there are natural caverns below the surface containing volatile materials, tunneling will give access to these, which can later be incorporated into the colony.

One possible adverse factor, which only time and experiment will resolve, is that humans may not be able to live happily without windows through which to gaze at the lunar landscape, there blue home planet, and the stars. But whether underground or surface, as the base grows it will be essential for it to develop into a city where people will *want* to live – bright, spacious, with trees and gardens, vegetables and flowers, not cramped, spartan, sterile and unwelcoming; though the early bases will of course lack much privacy and comfort.

The lunar colony is a chance to make a completely fresh start, away from the conditioning and attitudes imposed by living on Earth. Industrialist Neil P Ruzic, author of *Where the Winds Sleep* (1970), points out that the Moon also provides an almost perfect industrial environment. Its minerals are (at present) free of ownership; there is free vacuum; access to abundant solar energy for



heat or electrical power; a virtually infinite 'sink' for waste heat; low gravity for the more efficient performance of many industrial processes; no air or water to carry pollutants; and there is no plant or animal life with which to interfere.

Idealists and romantics may object to suggestions that our companion in space be turned into a vast industrial complex, but this is not likely to happen (and its appearance will not change to lovers under the night sky!). But it would surely be no bad thing if its function were only to take hazardous and poisonous industrial processes away from Earth, while leaving us with their benefits...

However, no matter how beautiful designs for future lunar cities may be, we must face the fact that they will never exist at all unless a strong case can be made for it all being worthwhile.

Farside astronomy

Astronomers, both optical and radio, would give a lot to be able to work on observatories on the Moon, which provides a firm base and thus more accurate pointing than an orbital telescope, with the same lack of atmosphere for perfect viewing plus 14-day freedom from sunlight. Farside is perfect for radio telescopes, for it is in the 'radio shadow' of the Moon's bulk, so free from interference from Earth's radio and other transmitters. But it is industry that will undoubtedly provide the biggest incentive to the politicians and guardians of the purse-strings. The history of the Moon's formation and evolution make it virtually certain that metallic ores will be found in abundance once exploration recommences, while the provision of oxygen for space operations should, as mentioned, ensure an early profit fom early lunar exploitation. Biological, and particularly genetic experiments could safely be isolated in reserved areas of the Moon, with no problems of airborne contamination or dager of bacteria or other organisms reaching public water supplies.

Being so close to home, a lunar base will make an ideal testing ground for expeditions and then bases further afield, such as Mars. It will also be a sociological experiment and Bob Parkinson expects that it would attract some of the more creative minds of Earth, thus becoming a fertile source of new ideas, providing solutions to problems and contributing to the arts and philosophy.

And finally, there is always the possibility that, in the event of the collapse of society on the parent planet (for whatever reason) a large lunar colony could provide a 'lifeboat' – an option for at least some of the human race to survive and continue into the future.

To be or not to be

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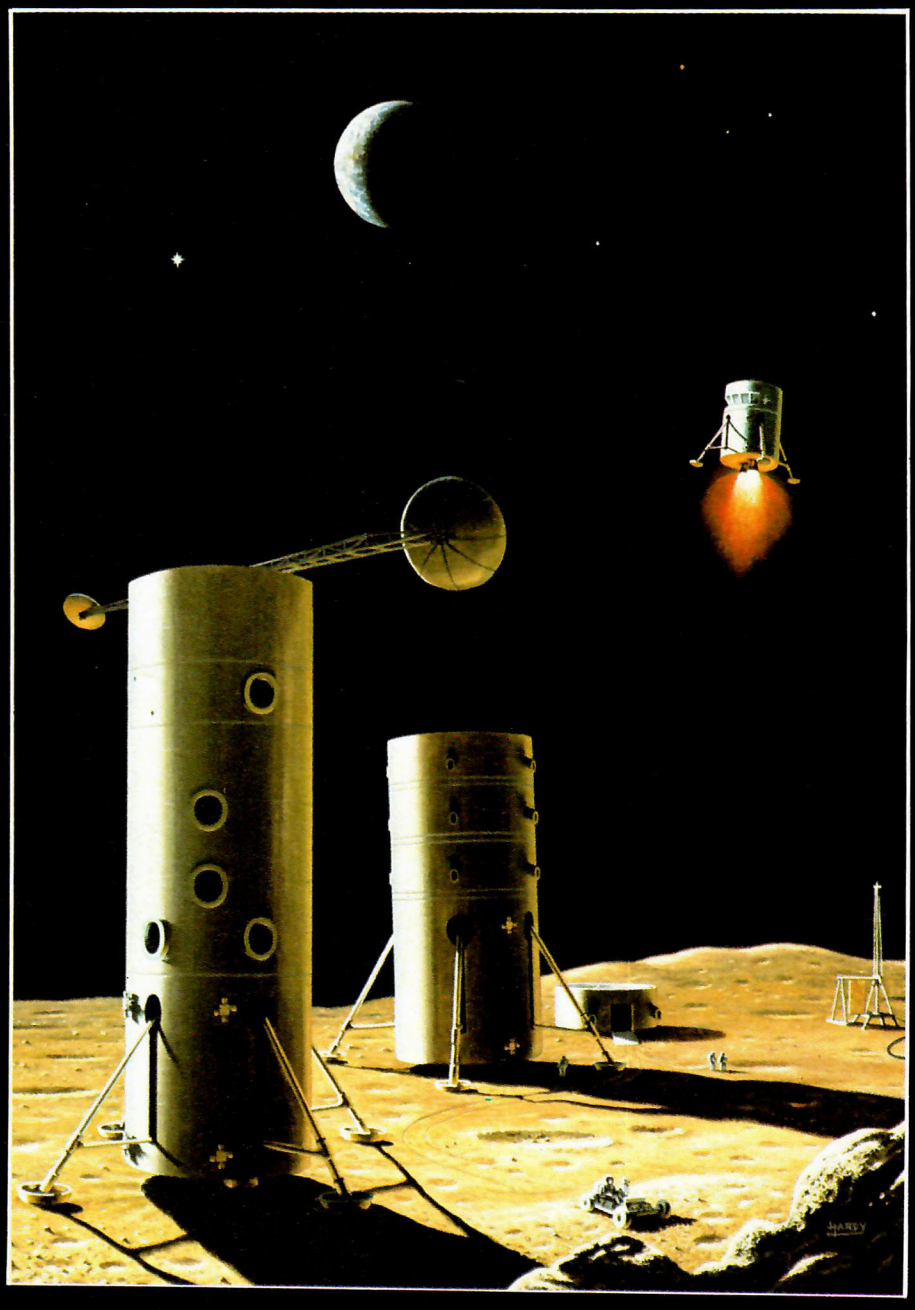
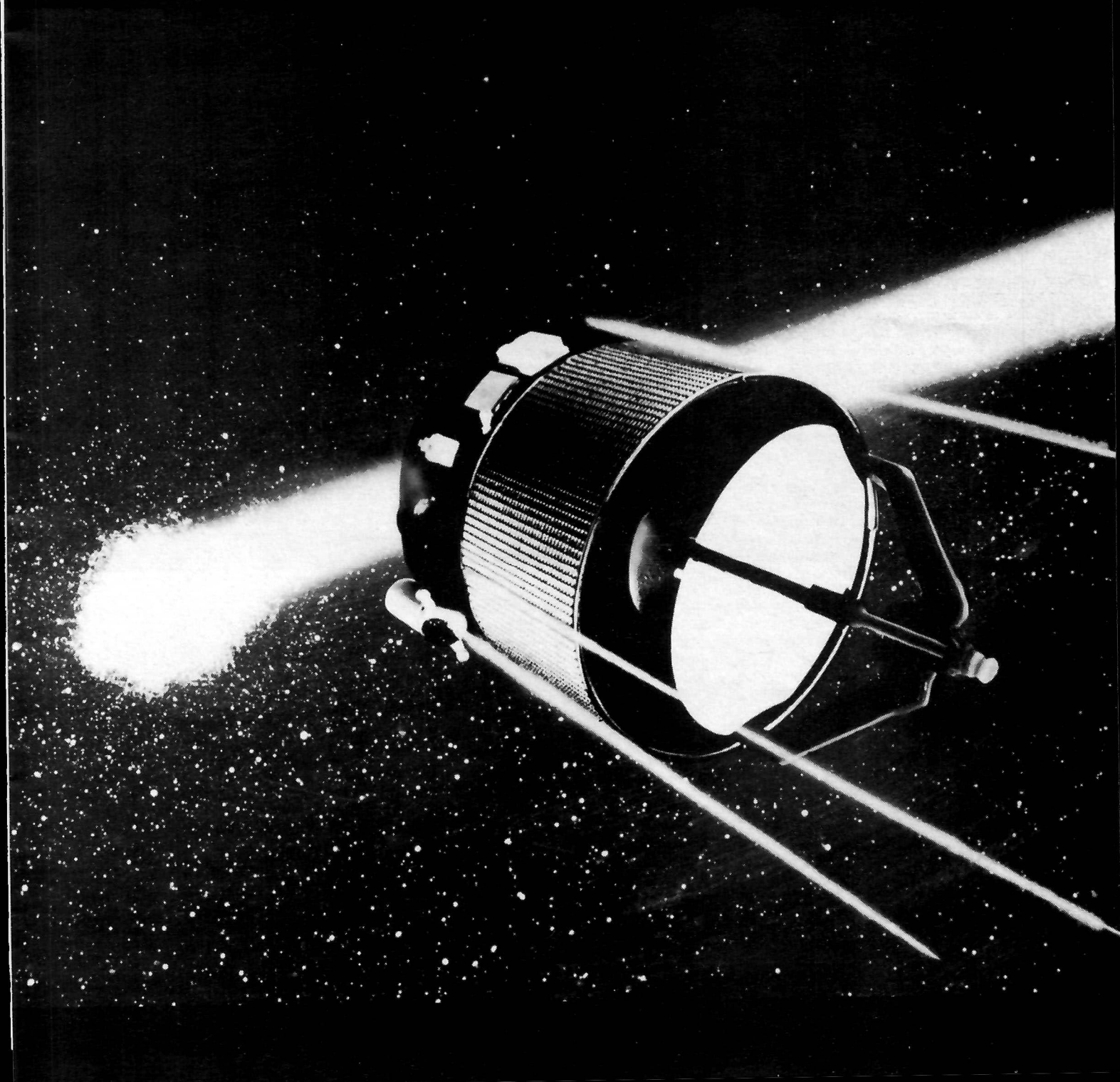
And finally, there is always the possibility that, in the event of the collapse of society on the parent planet (for whatever reason) a large lunar colony could provide a 'lifeboat' – an option for at least some of the human race to survive and continue into the future. A better alternative would be for space stations and lunar bases to become truly international – to co-operate instead of taking the arms race into space. Were this to happen, conditions on the home planet might become so much healthier that such a collapse would never occur.

In 1976 NASA published a study entitled Outlook for Space, which included this design for a pioneer lunar base. The cylindrical modules could also be used in Earth or lunar orbit as space station modules, and could be moved around or landed by means of the space tug seen landing. From New Challenge of the Stars by Patrick Moore and David Hardy, © 1977.



ENCOUNTER WITH HALLEY'S COMET

ALDO RABAIOTTI SURVEYS THE FLEET OF SPACECRAFT TAKING SHAPE ON EARTH IN READINESS FOR AN ASSAULT ON THE MYSTERIES OF HALLEY'S COMET.



Its nomadic 76-year voyage almost complete, Comet Halley has once again come into view of the 200 inch Hale Telescope at the Mount Palomar Observatory. The distant, blurry splotch was identified by astronomers D C Jewitt and G E Danielson on the 16th October 1982. It continues to barrel in towards us, becoming ever brighter with the passing months and by September 1985 it should be bright enough to be visible to small-scope astronomers near the star Eta Orionis with a visual magnitude of about 13.

It orbits the Sun in a broad ellipse that brings it to within 80 million kilometres of the Sun at perhelion and out to the edge of the solar system beyond the orbit of Neptune at aphelion. Its first appearance was recorded in 240 BC and since then it has kept time, once every 76 years, on at least 30 other occasions.

Although minor consituents of the solar system on account of their small mass, comets are, nevertheless, exceedingly complex phenomena and constantly pose challenging problems. The zodiacal light, for example, a faint glow in the plane of the Earth's orbit seen in clear skies just after sunset or just before sunrise, may be produced by very small particles from comets. The battery of questions that require answers makes the concerted Halley-watch effort that is soon to commence, a necessity. Coupled with the global International Halley Watch, will be the launch of a number of spacecraft to intercept Halley on it's way past Earth.

International Sun-Earth Explorer

By 1986, the enigmatic wanderer will have come under the scrutiny of hundreds, if not thousands, of ground-based telescopes, high altitude observation stations aboard aircraft and numerous spectra scanning instruments. In addition, the third flight of Spacelab could be arranged to coincide with Halley's most favourable approach. Spacecraft from the United States, Europe, Japan and two from the Soviet Union will be virtually falling over each other in their feverish attempts to glean as much information as possible about Halley before it disappears again until 2062. The joint NASA/ESA ISEE-3 was launched in August 1978 into a heliocentric orbit between the Sun and (at a distance of 1.5 million kilometres from the Earth). From this position, ISEE-3 carries out interplanetary measurements and records solar wind phenomena moving towards the Earth. Looking very like the European Space Agency's close encounter spacecraft Giotto, ISEE-3 has been moved from its position in halo orbit around the Lagrangian point between the Earth and Sun, to a number of other orbits giving best access to our planet's magnetotail.

In mid-1983, ISEE-3 was injected by a lunar swingby into an orbit which will eventually take it past the comet Giacobini-Zimmer on the 11th September 1985, the aim being to cross the comet's tail in March 1986 at a distance of some 3000 km from the nucleus. ISEE-3 should be approximately at the same solar distance fo 31 million km as Halley's comet at the time of the Giotto encounter, but the spacecraft will be at an awkward angular separation of about 20 degrees, limiting its usefulness. It should, nevertheless, provide valuable supplementary solar wind-monitored data complementing the Giotto flyby. Following this encounter, ISEE-3, its fuel exhausted, will be 120 million km from Earth and very likely beyond the range of NASA's sensitive Deep-Space Network receivers. It will not return to near-Earth orbit again until 2015.

Planet-A

The Japanese will also have a stand-off spacecraft monitoring Halley and unimaginatively dubbed – Planet-A. The launch of this spacecraft will be preceded by six months by the proving spacecraft MS-T5, which will have a two-fold function – to test Japan's modified M-3S solid propellant launcher and the country's new deep-space communications network.

The spacecraft will be launched on behalf of the Japanese Institute of Space and Aeronautical Sciences from the Kagoshima Space Centre in Southern Japan in August 1985. Looking very much like ISEE-3, it will be immediately injected into a path to intercept Halley, arriving on 8th March 1986, some six days before Giotto. Once the booster has been fired, its approach will be faster but unalterable which, assuming the worst, might result in a flyby many thousands of miles from the heart of the comet.

Planet-A will study the growth and decay of the coma as it approaches the Sun, the velocity of the expanding cloud of hydrogen atoms that surround the nucleus and, with ISEE-3, it will also scrutinise the solar wind activity around the comet, particulary its 'shock-front' where solar wind and cometary atmosphere collide. Measurements will be carried out with just two instruments – an ultraviolet camera and a solar wind analyser. The ultraviolet camera consists of an ultraviolet telescope, an intensifier camera and a charge-coupled subsystem to enhance incoming images to 125 x 150 line resolution. It has a 25 degree field-of-view and a resolution of one minute of arc – about 30 km from a distance of 100 000 km. Even so, the camera will not be sufficiently powerful to resolve the nucleus (thought to be 5 km in diameter), but it should be capable of picking out features of the coma structure. While Giotto will concentrate on the nucleus in relative close-up, Planet-A will direct its instruments at the comet's less specific features.

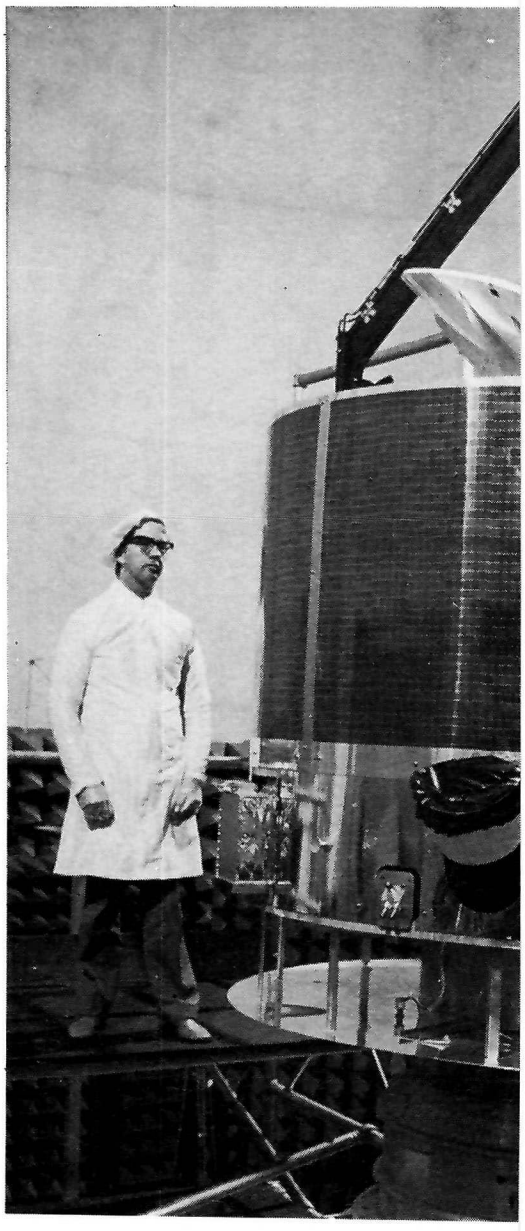
Venera-Halley

The Soviet contribution to the international Halley programme will be a combined, piggyback, Venus lander/Halley flyby mission. Two similarly equipped spacecraft will be launched on December 22 and 26th 1984 directly towards Venus. After dropping-off the Venus landers in mid-June 1985, the two spacecraft will use the planet's gravity to catapult themselves on towards Halley. The first will be within instrument range of Halley by March 8th 1986 when the comet will be at its brightest. The second Venera will flyby about a week later.

Although the spacecraft can be targeted with a precision of about 100 km the positions of the spacecraft relative to the comet's nucleus will be, in kind with Planet-A, within a few thousand miles. The Russians at this time may decide not to risk both their spacecraft on a close flyby and might alternatively opt to keep the first Venera at least 10 000 km from the nucleus, letting the second chance severe damage by flying in closer.

Scientific data will be recorded between $2\frac{1}{2}$ hours before closest approach to the comet and 30 minutes afterwards. In addition, two hourly spells of intensive data-capture will complement the measurements made at closest approach. The wide-angle camera will concentrate on the coma and act as a 'spotter scope' for the long-focus camera which will resolve surface detail to 200 m. These cameras will have 500 x 500 line resolution, but even so, complete images will not be transmitted – only frame sections amounting to one-tenth of total camera visibility, focused on areas of greatest brightness and obviously of most interest. This is because exposure times will have to be kept as short as possible to prevent the images from becoming blurred and 'burnt-out' – the spacecraft will be travelling at over 100 000 kph! In addition to their purely scientific functions, the cameras will provide data vital to aligning the instrument point platform (IPP) for best overall coverage. By photographing the comet prior to encounter, ground control will be able to determine the spacecraft's trajectory with reference to the comet's nucleus. This will enable them to pre-aim the IPP properly during

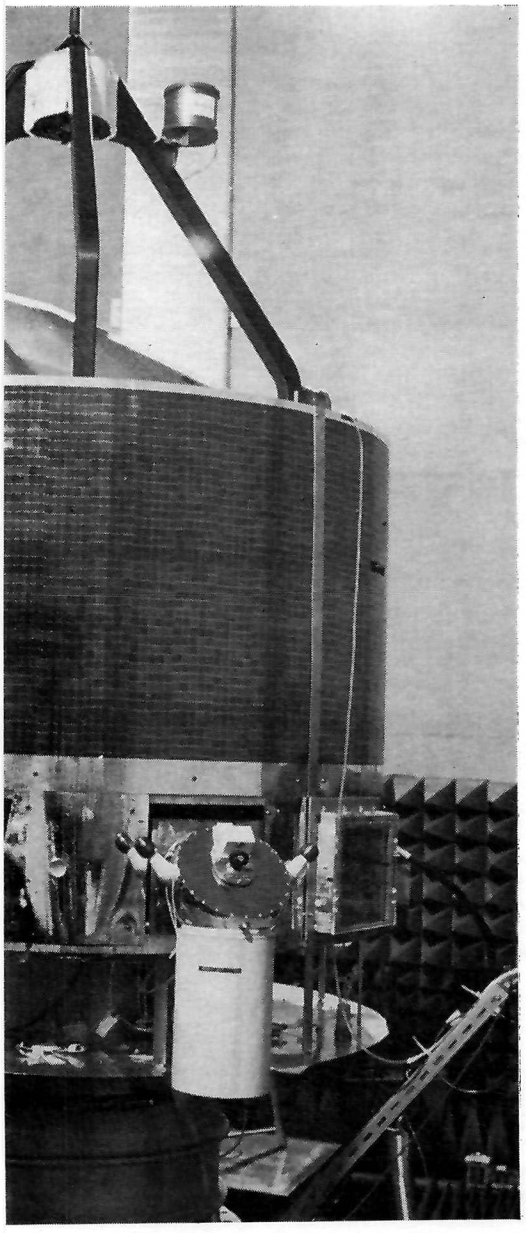
The electrical engineering version of Giotto in the electromagnetic compatibility test facility at British Aerospace, Bristol, which was used



the fleeting flyby lasting just a few hours. A spectograph, incorporating a 500 mm Cassegrain telescope, with a 140 inch objective diameter, will be used to study the dispersion and composition of the cometary gas(es) and a light-polarising technique will investigate the size, density and formation of the dust particles.

The camera/spectograph will provide infrared spectral data and images of the nucleus. These infrared observations should help astronomers deduce the temperature of the nucleus, its associated cloud of debris and the nature and temperature of the gas moecules. Aside from the imaging experiments, the Venera-Halley spacecraft will carry out several plasma investigations into the masses, wave phenomena and energies of the plasma and neutral gases of the coma. A magnetometer will take measurements of 'bow-shock' magnetic fields between the solar wind and the coma. A dust-detecting system, similar to that used aboard the Giotto spacecraft, will measure and record the numbers, impact points, velocities and directions of the dust particles striking the shield. It is very probable that both the Soviet spacecraft will survive their brush with Halley; but they will undoubtedly suffer some damage. Giotto, on the other hand, is expected to come to a more final conclusion.

to confirm that no unacceptable compatibility problems would arise between separate on-board systems. **Photo: British Aerospace.**



Giotto

In 1304, the Italian painter Giotto di Bondone recorded the passage of Halley in a fresco that is now considered to be the first scientific evidence of the return of a comet seen regularly for centuries. The European Space Agency's Ariane-1 launcher will lift-off from Korou in French Guyana carrying the appropriately named spacecraft for its encounter with that same wanderer seen by Bondone 680 odd years previously.

Giotto is now being readied for its suicidal mission at the Space Assembly Building of British Aerospace Dynamics in Bristol, Great Britain, with the support of a consortium of European space contractors for ESA.

Looking like a large biscuit tin, Giotto is nearly ten feet in height and almost six feet in diameter, is spin-stabilised, cylindrically-shaped and will rotate during its mission at a nominal 15 rpm. Solar panelling covers its surface shell providing the spacecraft with 190 watts, with an additional four silver-cadium batteries on stand-by to boost power output during the critical final hours of the mission and to provide vital back-up should the solar panelling become severely damaged.

A great deal of time and effort has been devoted to providing the spacecraft with protection for when it enters the hazardous debris surrounding the nucleus. The dual-sheet bumper shield will precede the body of the spacecraft, deflecting and suppressing hypervelocity dust particles. The advance shield is circular, of 1 m thick aluminium and is positioned 237 mm in front of a thicker 13.5 mm Kevlar/foam sandwich buffer screen. The shield is divided into three sections to aid experimentation and manufacture, the smallest of which is 'acoustically' (to limit vibration) decoupled from the rest of the structure and supports some of the dust impact sensors of the DID (Dust Impact Detectors). These sensors are located in the front bumper sheet and also acoustically isolated from the remaining structure. A shaped extended flue protects the PIA (Particle Impact Analyser) which protrudes from the circular edge of the spacecraft. This instrument will measure the mass and composition of the comet's envelope of dust. A further micrometeroid detector (CIS) is bonded to the shield's outer surface and it is likely that this instrument will disintegrate not long after the spacecraft has entered the coma.

Breaking the continuity of the shields, and consequently the spacecraft's overall protection is the centralised opening for the MAGE-1S engine which will be used only once to push Giotto on towards Halley from its Geostationary Transfer Orbit (GTO). A mechanism has therefore been designed to snap-shut the exhaust vent after the engine has served its purpose. Items of experimental instrumentation will be mounted on the upper and lower equipment platforms situated above the experiment platform and equipment vital to the spacecraft's performance will remain within the protective outer skin.

Kicking off

The mission itself will begin at perigree in the spacecraft's park orbit, when the solid-propellant engine will be fired kicking the spacecraft into a heliocentric orbit. Interception will occur on the night of March 13th 1986 when it will be 150 million kilometres from Earth, 133 million kilometres from the Sun and about a month after Halley's closest approach.

Giotto is being targeted to pass through Halley's coma to within 500 km of its nucleus on the sunward side. Allowing for orbital errors, Giotto is expected to penetrate to within at least 2000 km of the nucleus. The mission will be 'completed' just 15 minutes after Giotto has passed its closest point to Halley.

Ten experiments from a number of European countries constitute Giotto's scientific payload. One of the sensors is a multi-colour camera which will capture images of the comet's nucleus and surrounding coma. The other experimental units are concerned with the examination of coma chemistry; analysis and the dynamics of the cometary plasma and its interaction with the solar wind. Investigations will be made of the mass, distribution and composition of the dust cloud with an Ion mass spectrometer, a neutral mass spectrometer (which will be concerned with the coma's make-up) and a Halley optical probe experiment into changes in the physical properties of the dust and gas.

The operational life of Giotto has been scheduled for four hours. By the end of this period the environment will have become extremely hostile, because Giotto will be flying at very high speed, a consequence of spacecraft and comet travelling towards each other in a very finely measured 'head on' collision at 68 km/sec. Dust particles striking the outer shield will be travelling even faster, depending on their mass and size. If the particles are reasonably small (about 0.1 micron) the advance shield will absorb them leaving a peppering of tiny craters. Bigger particles might puncture the shield and in doing so they will be largely vaporised. Any debris traversing the 237 mm gap between the two shields will embed itself in the 'softer' Kevlar screen which can more easily dispose of the enormous momentum contained in these tiny fragments. If the coma is denser than expected and contains large amounts of micrometeroids, the spacecraft's stability might be affected.

Giotto will be under the control of ESA's Operations Centre at Darmstadt, West Germany. Transmitted data will be received at the 64 m Parkes Radio Telescope in Australia from where it will be beamed directly to Darmstadt. Giotto is costing almost 50 million dollars. Its unique mission profile should enable man to more fully understand exactly what Halley is. The combined spacecraft of the United States, Europe, the Soviet Union and Japan, the ground-based observation stations, associated measuring equipments and the global International Halley Watch will provide a flow of information about this most sought after phenomenon virtually unimaginable 76 years ago. 1984 marks not just the beginning of 'Orwell's' year, but of an unprecedented worldwide furore centred on that most enigmatic of celestial wanderers – the comet! It is unlikely Halley will ever witness such a concerted, almost maniacal, endeavour again, because Comet Halley will have been purged of all its mystery.

COMMUNICATIONS BANK

Trek music

In my opinion, *Star Trek II – The Wrath of Khan* was the best film ever made and, after reading the review of the record in issue 2, I looked forward to getting my record and I am pleased to say I agree with the review completely

In the review, Mat Irvine asked if Jerry Goldsmith had written any musical scores for any of the *Star Trek* episodes as even Marion van der Voort did not know of any publication listing the composers of each episode.

The answer to the query is that Goldsmith did not compose any music for *Star Trek*.

The required information can be found in *'The Star Trek Compendium'* written by Allen Asherman and published by Simon & Schuster, 1230 Avenue of the Americas, New York, New York 10020, ISBN 0-671-71945-1. The book was bought in America and so I do not know if it can be purchased in this country.

It includes a complete Episode Guide which lists all of the following composers:
Alexander Courage, Fred Steiner, Sol Kaplan, Jerry Fielding, Jim Henrickson, Joseph Mullendore, Gerald Fried, George Duning, Samuel Matlovsky and Richard Lapham.

Alexander Courage (who composed the theme music with Gene Roddenberry) composed most of the first season but the last two seasons were composed by various people.

Incidentally, did you know that the original television theme music had words? They were published in *'The Making of Star Trek'* by Stephen E Whitfield and Gene Roddenberry, published by Ballantine Books.

Thank you very much for a great magazine. Keep it up!
Leighton Buzzard *David Cundell*
Bedfordshire

Ed: *Thanks for your kind remarks about* Space Voyager. *David kindly sent me the lyrics of the* Star Trek *theme, but unfortunately there wasn't enough space to publish them here . . . and there's also the matter of copyright. But at least you know where to find them now.*

More SW characters

After reading your comments in issue 9 about Mark Smart's letter, I feel I must write to say that the *Star Wars* Who's Who is most definitely not finished. Please add the following:
ANCHORHEAD: Luke rushes here to tell his friends of the space battle in *Star Wars*. ATE-DEE-ATE (8D8): Robot torturer in Jabba's Palace. BEEDO: Appears briefly in Jabba's court, relative of Greedo. CAPTAIN NEEDA: Captain of the Star Destroyer Avenger. COMMANDER WILLARD: Commander of rebel base on Massassi. ELOM: Hairy creature in Jabba's Palace and on Sail Barge. EPHANT MON: Seen in Jabba's Palace. EVEE-NINE-DEE-NINE (EV-9D9): Chief of Jabba's Cyborg Operations. GENERAL JAN DODONNA: Briefed pilots before final attack on Death Star in *Star Wars*. ISHI TIB: Creature of Jabba's Court. KLAATU: *From Return of the Jedi*. LOBOT: Lando's main aide on Bespin. MOS EISLEY: Spaceport from where Luke, Ben and the droids meet Han Solo. MYNOCK: Black, bat-like creature. OOLA: Dancing girl of Jabba. PAPLOO: One of the major Ewok scouts. PESENBEN IV: Planet where Lando ran a lithium scam to fool the Imperial governor into leasing the planet. TATOO I, TATOO II: The binary stars that Tatooine orbits. TEEBO: One of the Ewok leaders. TIE INTERCEPTOR: Has same bubble shape as normal TIE fighter, but has angled solar fins with a large section removed. TREADWELL: Small 6-armed robot. REE-YEES: Creature with three eyes on stalks, in Jabba's Palace. WEEQUAYS: Guards on Gun Skiff, totally bald but for Tribal top-knot.
Withington *Paul Smith*
Glos

How many more Star Wars characters are there? See 'More SW characters'. **Photo: 20th Century-Fox.**

Ed: *I should have known better, shouldn't I? It was a mistake to suggest that there couldn't be any more* Star Wars *characters lurking about after Mark Smart's comprehensive addendum in issue 9 (June/July).*

Back numbers

I recently came across a copy of *Space Voyager* (No 9) and I was very impressed with it, to such an extent that I would like to obtain copies of Nos 1 to 8 inclusive.

After trying many local newsagents, I contacted the main magazine and newspaper distributor in this area. They have assured me of two things – 1, that *Space Voyager* is now called just *Voyager*, and 2, that back copies are not available any more. Please can you help by telling me if this is so. If not, please let me know how I can obtain copies.
Barnsley *Andie Nixon*
S Yorkshire

Ed: *Well, your distributor is almost correct. Back numbers aren't available any more. However, on my travels round London, I've come across lots of back numbers of the magazine in specialist science fiction/fantasy bookshops. That's not much use to you in Barnsley, though. If a bookseller in your area who still stocks back numbers of* Space Voyager *could contact us, we'll publish the shop's address, so that you can pop round. Alternatively, try contacting* 'At The Sign Of The Dragon', *131 Sheen Lane, London SW14 8AE (tel: 01-876 3855), or* Odyssey *7, Science Fiction Bookshop, 1st Floor, Manchester University, Precinct Centre, Oxford Road, Manchester (tel: 061-273 6666), or* Andromeda Bookshop, *84 Suffolk Street, Birmingham B1 1TA (tel: 021-643 1999).*

As far as the magazine's name is concerned, it's now Space Voyager. *In fact, it's been called* Space Voyager *since issue number 5. It has gone through a couple of transformations on the way to the present title, and it's often referred to, even now as simply* Voyager, *so it's not surprising that your distributor made a slight error. To avoid disappointment in the future, why don't you take out a subscription?*

Scaling down rockets

Having since being a young lad nurtured the dream of small spacecraft and seen your article on model rocketry – can you answer for me, or advise me where to look for an answer, this question.

What exactly forces rockets to be so large – why cannot a far smaller version exist, simply to allow two men to be carried, no massive payload?

I appreciate this may need a whole article, but are there some basic facts and equations?
Much Birch *J Norris*
Hereford

Ed: *Indeed, not a bad idea for an article, Mr Norris. I won't get into equations here – I'm not in the least qualified to do so anyway. However, I think I can offer some useful thoughts. Perhaps the best known man-carrying rocket is the three-man Apollo programme's Saturn V. If you look at the tiny part that brings the astronauts back to Earth, it looks very small indeed beside the launcher. Even if you take the hardware necessary for the mission away (the lunar and service modules), the rocket still looks pretty massive.*

It has to be that big to hold the fuel necessary for the flight. In terms of volume, the payload and engines form a smallest components of the system, the major part being fuel. If you tread water in a swimming pool and throw a heavy weight in one direction, the effort of throwing the weight will push you back in the opposite direction – Newton's third law of motion. The lighter the weight, the smaller the force pushing you back. Rockets use the same principle – ejecting a very reactive, but more significantly, a very light fuel from the bottom to push the rocket upwards. Because the fuel is so light, it has to be ejected very

rapidly and so lots of it is required. Hence the huge size of the rocket itself, which is mostly a fuel tank.

Calling UFO clubs

I am interested in UFOs and have been for seven years, although I am having trouble finding a club or society. I would be very grateful if you could help me. As you might know, there have been a lot of sightings near here – Todmorden, Hebden Bridge, etc. Although I have tried to research, I have no club or society to back me up. I have read the reports in *Space Voyager,* my favourite magazine. The UFO sightings happened here a few years ago, but I am still puzzled. If you could help me join a UFO club or society, I would be very thankful. I'm also very interested in the magazine, *'Flying Saucer Review'.*

Halifax *Geraldo McBride*

Ed: *If any UFO clubs in the Halifax area would like to write in, we'll publish their names and addresses for Geraldo (wasn't he a band leader in the 1930s-40s?)*

Oh no, not again!

Yes, it's me again – the Gilbert Harding of the fantasy media. Good to know that my criticism of *Terrahawks* has met with such a spirited response, and I particularly want to thank the nameless reader in issue 10 for his useful list of Gerry Anderson productions. As far as the *Captain Scarlet/Joe 90*-style 'proportioned' puppets 'failing to please the public' is concerned – well, all I can say is that if it's true (and I presume it must be, since this reader obviously knows his stuff) the public must have been a pretty undiscerning bunch. I was just a kid when *Captain Scarlet* was first screened – it certainly captured my imagination and I bought most of the merchandising (including a huge plastic *Captain Scarlet* cap, which didn't fit me).

David Warner in Tron – does TV's Automan mimic Tron's special effects. See 'Oh no, not again!'.
Photo: © MCMLXXXII Walt Disney Productions.

Having exhausted the subject of *Terrahawks* (except to ask where the promised article on the series has got to) I now turn to the letter by Wendy Metcalfe regarding *Battlestar Galactica.* 'Bad taste poisoning the minds of the young' . . . Good God, did I really say that? Okay, explanation time.

I would certainly agree with Mrs Metcalfe that *Battlestar Galactica* does deal with very serious subjects such as war, famine, murder, etc. However, the fact that a series deals with such subjects does not mean that the end result is of a particularly high quality. *The Incredible Hulk* dealt with some pretty harrowing subjects in its time: child abuse, physical disability, etc. *Crossroads,* during its long history, has handled such topics as mental illness, unemployment, racism, religion, prison, corruption and even witchcraft. Whether or not these series have treated their subject matter with any real skill is debatable. Other series such as *The Twilight Zone, Lou Grant* and *St Elsewhere* treat serious subjects with great skill and these are the type of show that stand out as 'classic' material.

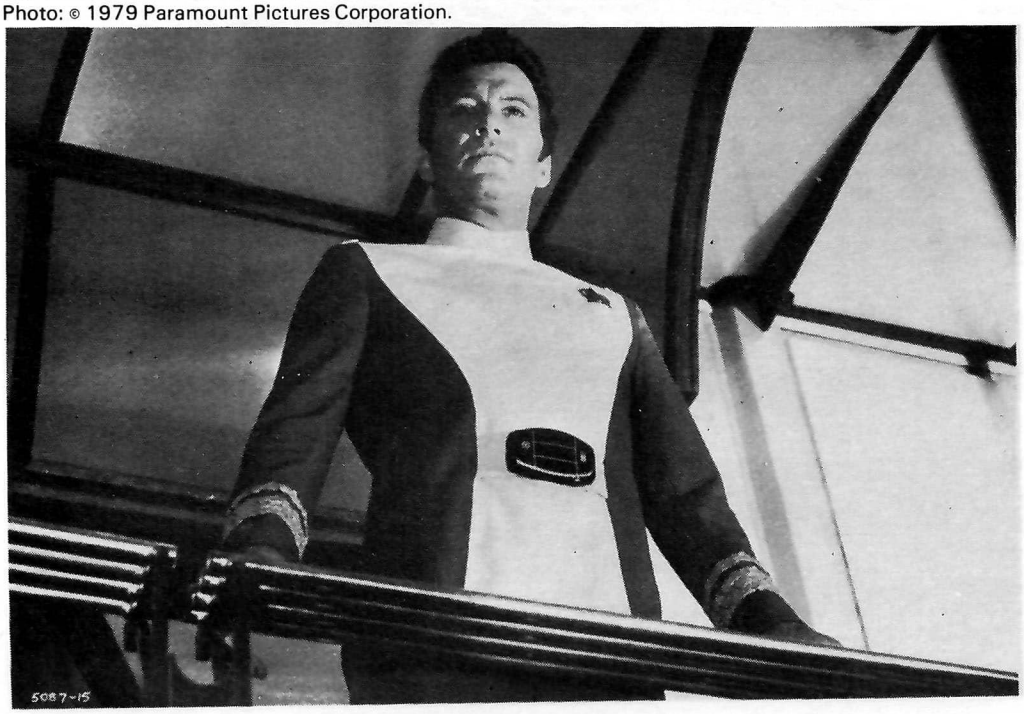
Even *Space: 1999* (much maligned by SF purists for reasons which need not concern us here) had its moments. One episode, guest-staring Leo McKern, dealt with loneliness and handled it very well. Incidentally, *Space: 1999* remains one of my favourite Anderson shows – though the second season, marred by changes in production staff, music, story direction and casting, was extremely embarrassing at times (if you remember the absurd 'shape-changer' Maya changing into a gorilla you'll know what I mean).

But hey, I'm getting way off the subject. My main objection to *Battlestar Galactica* is that it is a fairly typical mainstream American TV production. The graphics, music, camerawork, lighting and overall 'feel' of the series all have that distinct lack of imagination that is all too common in American television today. And let's not kid ourselves – *Battlestar Galactica* was just a *Star Wars* rip-off, in the same way that *Tales of the Gold Monkey* and *Bring 'em Back Alive* were derivatives of *Raiders of the Lost Ark;* the puerile *Whizz Kids* followed *War Games* in the same way. And *Automan* – in terms of special effects at least – was just a poor man's *Tron.* That's the way American TV is today (apart from the obvious quality shows such as *Taxi, Hill Street Blues,* etc) – there's no magic, no atmosphere. There's none of the sense of period that you get from a beautifully conceived series such as *The Twilight Zone* – or, for that matter, other series such as *The Outer Limits, Star Trek* and so on. And, let's face it, the 'nostalgia' element of many of the classic SF/fantasy series is a major part of their appeal. I can't get nostalgic about a series that dates from 1978. Add to all this the fact that I will always identify Lorne Greene with Ben Cartwright and you begin to get an idea of why *Battlestar Galactica* leaves this viewer unimpressed.

As for my comment about 'bad taste' – admittedly a rather vague reference – well, to my mind, preferring *Battlestar Galactica* to *The Twilight Zone* is on a par with preferring the *Scarecrow and Mrs King* to *The Avengers;* or saying that *The 'A' Team* (yuk) is a better show than *The Man From U.N.C.L.E.* I hope that gives a better idea of what I mean – though I supposed you're going to get letters from mohawk-headed 12-year olds saying that *The 'A' Team* is ace. Takes all sorts.

Okay, controversy over. Just a few words to say that the Trouble-Free Astronomy article was terrific – its refreshing to see that you're encouraging your younger readers

Star Trek comes under the Williams focus – Admiral Kirk awaits the verdict. See 'Oh no, not again!'.
Photo: © 1979 Paramount Pictures Corporation.



COMMUNICATIONS BANK

to take such an active part in the magazine (indeed, this 'reader participation' angle makes *Voyager* unique in its field) and I should imagine that Kirsty was pleased with the way her excellent article was presented. Now, about those record reviews I sent you . . . go on, I can take it: they weren't any good, were they?

Mayhill *Graham Williams*
Swansea

Ed: *Now then, where to start. First of all – the nameless reader in issue 10. I must thank Steve Slaughter of Brentwood, Essex, for sending in that list of Anderson productions and apologise for not immortalising him in the customary way.*

Now to the elusive Terrahawks *article. I commissioned Mark Gorton of Granada Television to write said article for the June/July issue. The deadline came and went and nothing arrived from Mark, either for that article or his regular* SF on Video *column. A phone call elicited the worrying news that both articles with their photos had been dispatched to* Space Voyager *some time previously. They hadn't arrived and stubbornly continued to not arrive. The obvious answer was to secure a copy of the text and start from scratch gathering photos again. BUT, and it's a monumentally huge BUT, Mark couldn't lay his hands on a copy of the text for the* Terrahawks *article. As it was, the* SF on Video *text copy was delayed in the post to such an extent that it arrived too late for inclusion in the June/July issue and was held over for the Aug/Sept issue. The* Terrahawks *article still has not come to light.*

I agree with your comments on Space: 1999. *I enjoyed the first series enormously, but my interest waned in particular when Maya joined the cast.*

Thanks for sending your record reviews. My answer to you must be the same as that which I've had to give to many contributors of late. I'm leaving the magazine once this issue goes to press. Naturally, the material for this issue was conceived and commissioned quite a while ago so that the issue could go into production around the middle of May (yes, really – May!). So, I'm afraid the issue was 'full up' for some time before that. When I finally hand over the editorial reins to Wendy Graham, I will either return contributions received or pass them on to Wendy.

Alias Captain Antilles

In the last copy of *Voyager,* I, apart from a great many other features, enjoyed the *Star Wars* Trilogy Test. I, like so many other people, am an avid *Star Wars* fan.

I recently read, for the twentieth or so time, the book *Star Wars* by the man himself, George Lucas.

On page 51 of the book, to quote C-3PO, 'Quite frankly, sir, I don't know what he's talking about, (referring to R2-D2). Our last master was Captain Colton. I never heard Artoo mention a prior master . . .'

Question number seven in the *Star Wars* section of the Trilogy Test is: Who was R2D2 and C-3PO's master before being bought by Uncle Owen?

The answer given on page 63 is Captain Antilles. I have only seen *Star Wars* three times and can only presume that the name was changed for the film. Or, has someone made a cosmic cock-up!? Perhaps other readers know. Is it, as I think, a name change for the film? If this is the case, may I be deported to the spice mines of Kessel for questioning!

Before I saw *Return of the Jedi,* I heard wild rumours that all the main characters are, to use a *Star Wars* phrase, 'terminated'. At this time, I did not believe that Luke and Vader were father and son.

However, I did have a slight suspicion that Leia may be related to Vader: in the *Star Wars* story book, there is a photo of Grand Moff Tarkin, Vader and Leia, just as the first Death Star is about to destroy Alderaan. Vader had his hand on Leia's shoulder, rather protectively I thought, perhaps trying to give her some strength through the force?

I do realise that Vader, at this time, did not know that Leia was his daughter, but it is my belief that Anakin Skywalker, within Vader, may have had a slight conscience as Alderaan was destroyed.

We all know that Vader is not all bad, from *Return of the Jedi,* so perhaps this is a possibility.

You have an excellent magazine. Keep it up! May the force be with you!

Wendover *Alex Manning*
Bucks

Ed: *The force is gratefully accepted – it's been directed to the Guardian of the Cosmic Cock-ups. I know that Simon Goodall, author of the Trilogy Test keeps a weather eye on Communications Bank, and I'm sure that not many Suns will have set by the time an explanatory missive plops onto the doormat at Castle Voyager.*

Clone Wars . . . or not?

In the *Letter From Hollywood* article by Randy and Jean-Marc Lofficier in issue no 10 (Aug/Sept), it was reported that the next *Star Wars* episode may be sub-titled *The Clone Wars.*

I would first discount any rumours about the titles of *Star Wars* episodes. After all look what happened to *Revenge of the Jedi,* which became *Return of the Jedi.* With the amount of, and the time and effort put into, security on *Star Wars* productions, I would take this Hollywood rumour as being the first of a very large and complicated security operation by Lucasfilm Ltd.

I enjoy *Space Voyager* very much, so please keep up the high standard and work put in by all the team involved in the production of *Space Voyager.*

Liverpool *Gerard Gilligan*

2001 Bludners

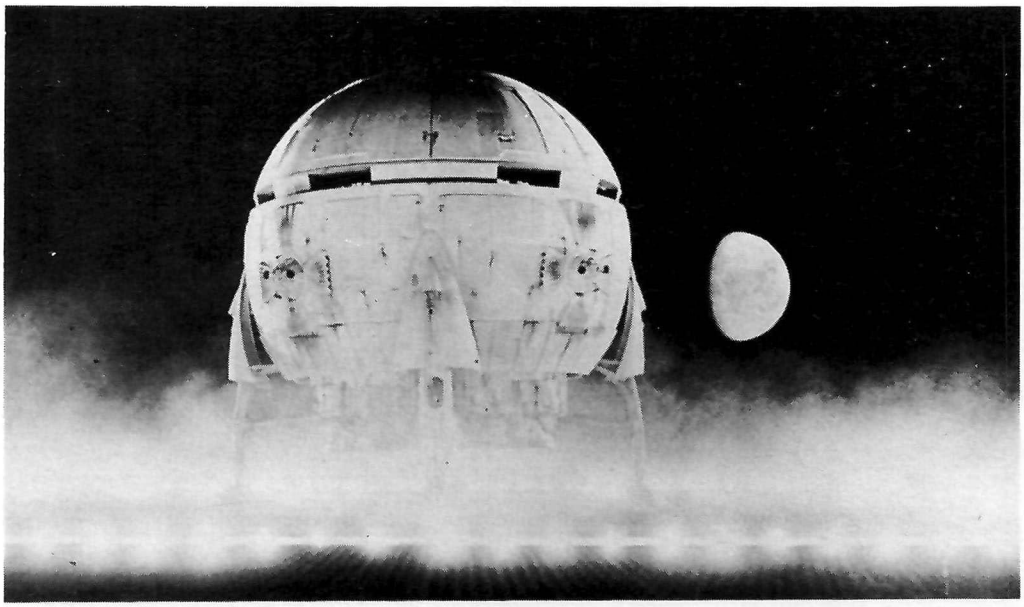
I was interested to read two recent *Communications Bank* letters on *2001* blunders, though felt that the two main faults described by Mr Lane and Mr Clay (1. The Aries 1B drinks and 2. The Discovery's moving starfield) can be easily excused and put down to 1. suction and 2. The Discovery was supposed to be travelling in excess of 200 000 mph, and after all, it was a very slow starfield. Even so, these would be minimal errors when compared with the five major errors I hated myself for spotting in a recent viewing of this exquisite film.

1. Theoretically, the Discovery's carousel is the only area where artificial gravity is present, so why does it exist in the pod bay?

2. Consider the interior of Discovery's main sphere. It contains:

(a) A two-man flight deck
(b) A large pod bay which takes up just over one third of the sphere
(c) HAL's somewhat roomy zero-G memory banks
(d) A giant artificial gravity carousel
(e) A padded emergency airlock

Return of the Jedi – rumours of character termination. See 'Alias Captain Antilles'. Photo: 20th Century-Fox.



Unwanted animation in the skies – a stellar aberration? See '2001 bludners'.

chamber with enough room for at least two Ford Fiestas!

Now looking at a photo of Discovery, try and fit them all in. It's just not possible. Try as I might, I can't get the carousel to fit between the pod bay and the flight deck, and it won't stand on end without intruding into the pod bay. At best, the emergency airlock would have to intrude nearly halfway into the pod bay knocking pod 1 off its platform in the process.

3. Bowman's pod rotates the emergency airlock opener with one arm. Surely the physical laws of action and reaction would spin the pod in the opposite direction.

4. When Bowman enters through the airlock, the blast of air from the rapidly depressurising pod blows him into Discovery's airlock. Fair enough, but again, the physical laws of action and reaction would have sent the pod hurtling off into space, but sadly, as Bowman manages to close the airlock, the faithful pod is still there.

5. Finally and probably funniest of all, on Bob MCall's terrific artwork for the film's poster and LP cover is a mega-mistake. Ignoring the fact that the loony pilot of Orion, the spaceliner, is generating enough thrust to seriously endanger the stable orbit of the space station instead of gently manoeuvring away, we see 12 astronauts tethered to the station's girderwork. Did nobody inform these people that on a rotating space station they would be flung to the ends of their lines with nothing to do but count stars or play 'I spy'? Maybe they weren't working at all, but indulging in the 21st century sporting craze of orbital dangling!

Thanks for a first class magazine, though more modelling features would be nice.

Marton *Mike Conroy*
Blackpool

Ed: *What's this? – Ford Fiestas in 2001! Comments please on Mr Conroy's fault-finding fling.*

Pot-pourri

I was recently reading your excellent publication while travelling on British Rail Southern Region, an experience which has several characteristics in common with a jump into hyperspace in that you can never be sure where you are going to end up or when. Be that as it may, my eye was dawn to R C J Clay's letter pointing out the moving star fields in *2001*. He or she is absolutely correct about these, for I have seen the film many time and those damned stars remain one of the few flaws in what is otherwise a cinematic masterpiece. I know of no piece of fancy intellectual footwork to justify them.

Moving on to Wendy Metcalfe's defence of *Battlestar Galactica*, I feel I should note that her argument does not stand up. It is not enough for a film (or indeed any work of art) merely to address a topic that is worthy, it must also deal with that topic coherently. Take as an example *Plan 9 From Outer Space*. This film concerns the idea that not only is there intelligent life in outer space, but also that sentient aliens may already be among us. This did not prevent the film from being a total failure.

I give you one example of lack of thought which was demonstrated throughout *Battlestar Galactica*. In one episode, part of the Galactica was set on fire. The fight against the blaze took up a fair proportion of the climax of the story. Several fire-fighting techniques were tried. They all fail. Suddenly Commander Adama has a brilliant idea. He decides to seal off the area of the ship which is burning and let the air out to put out the fire. This simple solution was then treated by all as a stroke of genius. Why it should have taken members of a society which has supposedly been travelling in space for centuries so long to think of the obvious is quite beyond me. Interestingly enough, this method was referred to as 'letting the vacuum in' which is a strange (though not invalid) way of describing it.

Let's face it, *Battlestar Galactica* is just a Cold War parable with the Cylons standing in for the 'Commies' and a series of plots which show lily-livered politicians almost but not quite stopping our brave uniformed lads from stomping the bad guys. It must have been the Pentagon's favourite programme. After all, it was pitched at their level.

Now on to more serious things, like nit-picking! I refer to the article 'Reaching for the Stars' by David Hardy. In his section on the Doppler Effect, he raises once again the old chestnut about the stars seeming to change colour when viewed through the windows of a spaceship travelling at some respectable fraction of the speed of light. I too swallowed this one for years, but it is wrong. Stars give out radiation over a wide range of wavelengths. This means that when the light from a star is blue or red shifted, light which was previously invisible is shifted into the visible range, thereby topping up the wavelength spread of the perceived image and keeping it more or less the same colour. There may be slight changes in shade of course, depending on the mix of elements in the star. This fact was brought to my attention when I attended a lecture on interstellar travel delivered in 1979 by Dr Robert L Forward. He displayed a painting of his own depicting the colour shift and then admitted to his audience that it was wrong but that he had not realised this at the time that he painted it.

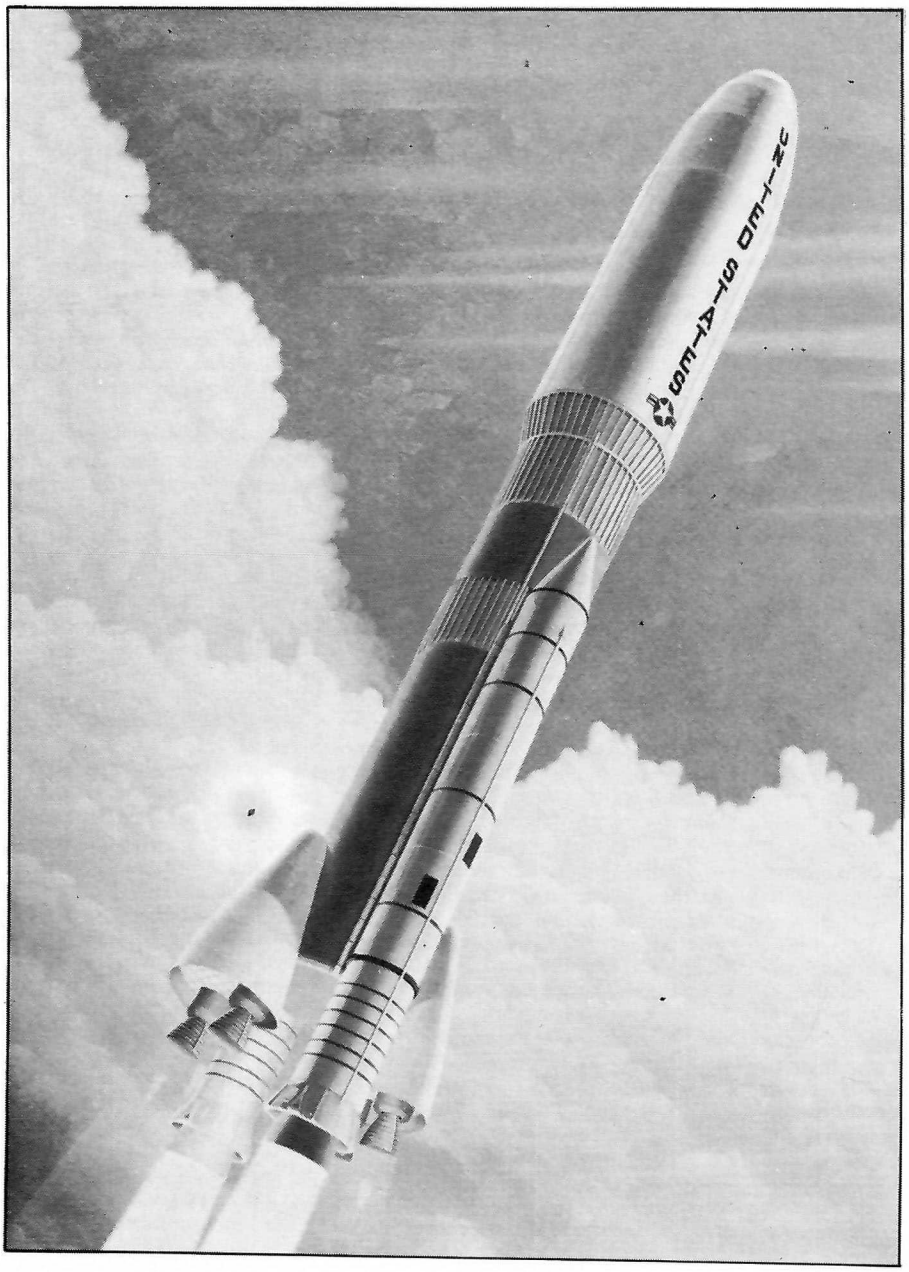
I conclude with a reference to something with no connection whatever to the preceding paragraphs. In 1889 was published Lewis Carroll's least known work, *'Sylvie & Bruno'*. In chapter 8, at a tea party, Lady Muriel remarks as a gentleman carries a tea cup for her, that if cups of tea had no weight at all, then perhaps ladies would sometimes be permitted to carry them. Another character, named Arthur, replies that if the house was placed billions of miles above a planet and then let fall, all the objects it contained would be weightless with respect to each other, including the tea-cups. Is this the earliest literary reference to flying saucers?

Mitcham *Kenneth Mann*
Surrey

Ed: *Answers to the Doppler Shift riddle from quantum physicists to Communications Bank as soon as possible please!*

SHUTTLE DERIVATIVES

THE NEXT GENERATION OF SPACE HARDWARE MAY BE BORNE OUT OF DEVELOPMENT WORK ON THE SPACE SHUTTLE. IAN GRAHAM REVIEWS THE SITUATION



Aerospace manufacturers are taking a second look at some of the components that make up the Space Shuttle re-usable transportation system. Other transport vehicles could be powered by its main engine. Launch rockets could be based on its enormous external fuel tank. The Space Shuttle is certain to spawn a new generation of space vehicles.

Martin Marietta, who developed the external tank, are looking at a variety of cargo-carrying options, using the external tank's one and a half million pound fuel-carrying capacity. The designs broadly involve strapping an engine module onto the tank and, if necessary, boosting the thrust produced by strapping solid rocket boosters onto the side. By using more than one engine module, all feeding from the same external tank, the instantaneous thrust can be increased, but of course the maximum duration of engine burn is reduced.

Despite the fact that the tank breaks up as it falls back to Earth from the Shuttle Orbiter, it is in fact a very sturdy structure. At launch, it absorbs the total 1,400,000-pound thrust loads of the Orbiter's three main engines and two solid rocket boosters. Underneath its inch-thick layer of spray-on polyurethane-like foam thermal insulation, the 154 feet long outer skin hides three fuel tanks, a forward oxygen tank, an aft hydrogen tank and an intertank connection between the two. The fuel is delivered at the staggering rate of over 1,000 gallons per second to the Orbiter through 17-in diameter feed lines.

When the tank separates from the Orbiter, 70 miles above the Earth's surface, some fuel is left in it to cause a tumbling motion. This stops the tank skipping across the upper atmosphere and making its landing point

An artist's impression of a Shuttle-derived cargo vehicle, inline II. To increase thrust, two main engine modules, each fitted with two engines, take fuel from a single central tank flanked by two solid rocket boosters (SRBs). Photo: Martin Marietta.

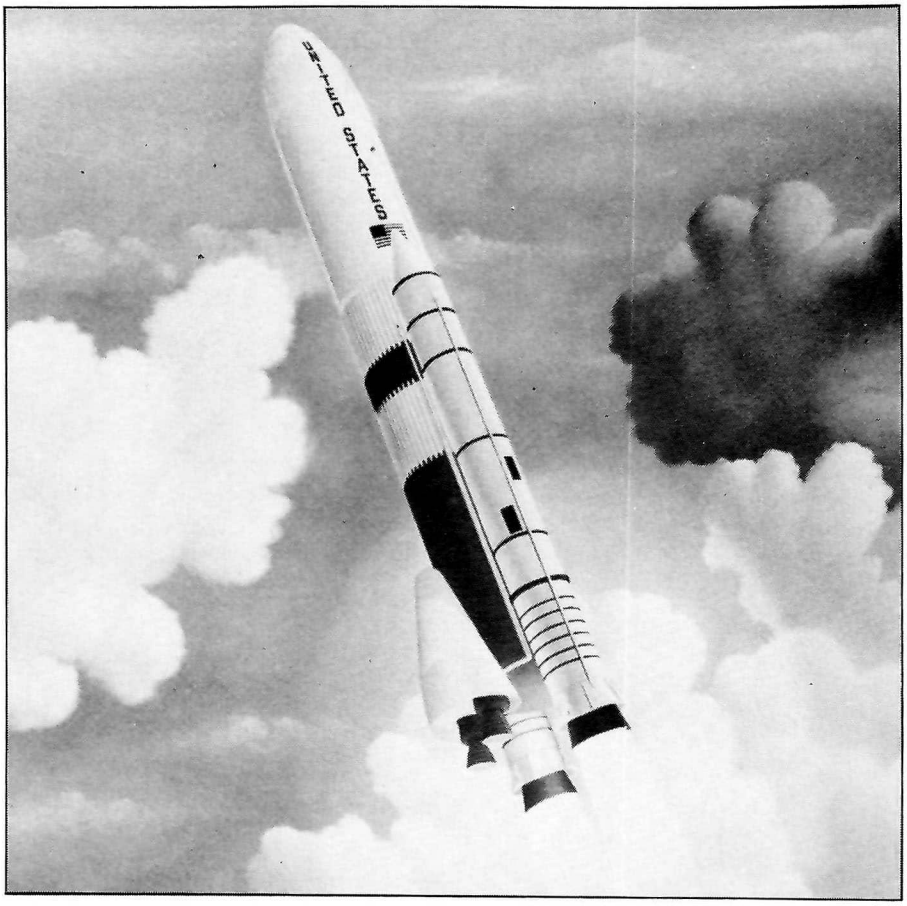
Right: This artist's impression shows a rather different approach to the Shuttle-derived cargo vehicle design – the payload and engine module is strapped onto the side of the fuel tank in the same manner as the Shuttle Orbiter. Photo: Martin Marietta.

dangerously unpredictable. Tumbling also causes the tank to break up at about 185,000 feet. Its job is done after only eight minutes of flight.

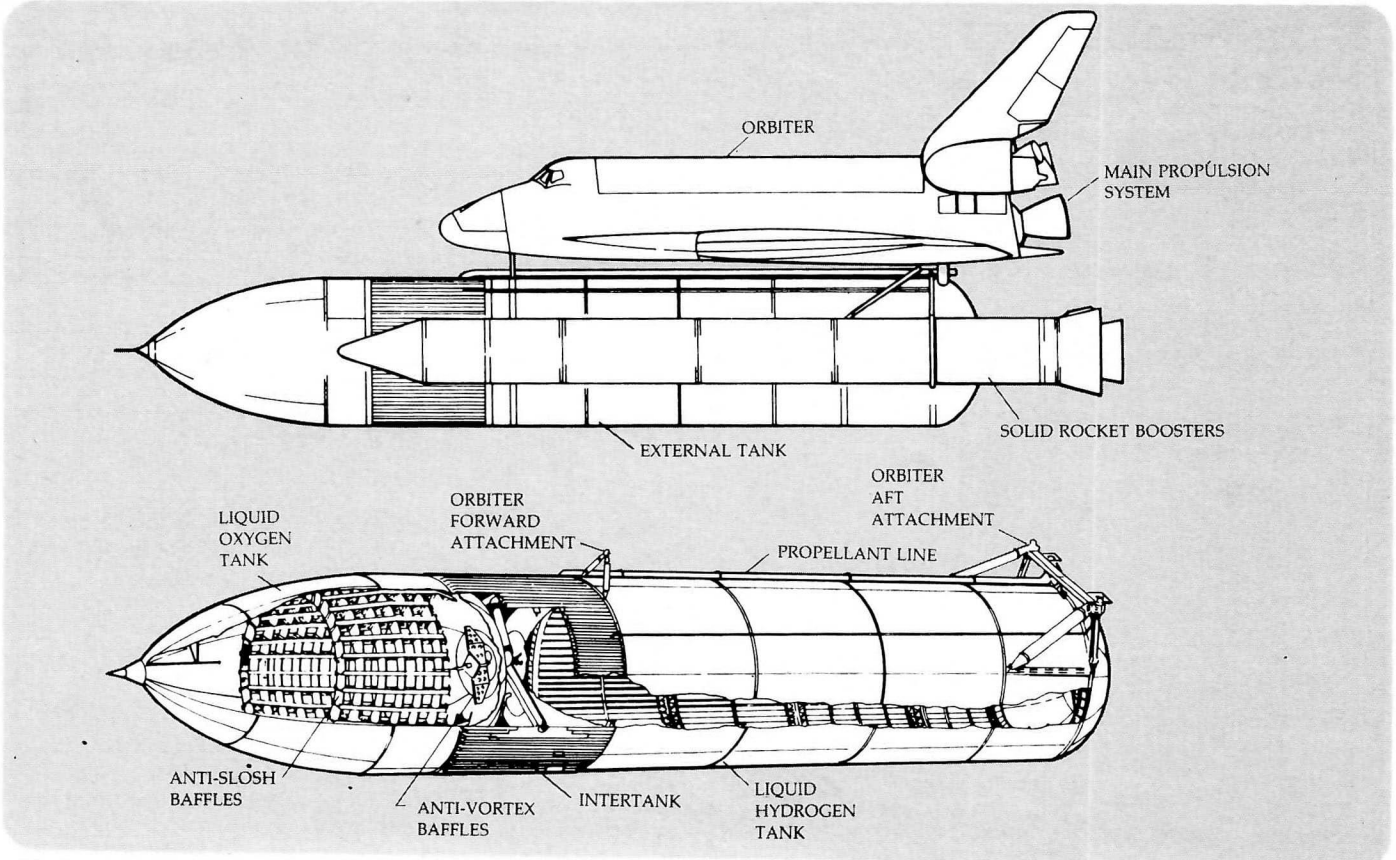
Despite its apparently unchanging appearance, the external tank continues to evolve and change. NASA's Marshall Space Flight Centre, which manages the external tank programme, requested that the manufacturer redesign it to reduce its weight by no less than 6,000 pounds. The first lightweight tank was scheduled for the eighth flight. External tank construction is a profitable business now for Martin Marietta, whose Michoud Division is tooling up to produce 24 per year for Shuttle flights. If the tank is also incorporated in other vehicles, production will have to be stepped up even further.

Boeing Aerospace are also looking closely at the Shuttle derivative business. They have plans for a cargo launch vehicle and, with forthcoming space station projects in mind, an Orbital Manoeuvring Vehicle (OMV). The cargo launch vehicle would consist of a shortened Space Shuttle external tank feeding to a single Space Shuttle main engine. This central assembly is flanked by two shortened Space Shuttle solid rocket boosters, one mounted on each side. That's the launch vehicle part. The cargo part is in the form of a large cannister shroud containing the upper stage and payload or payloads.

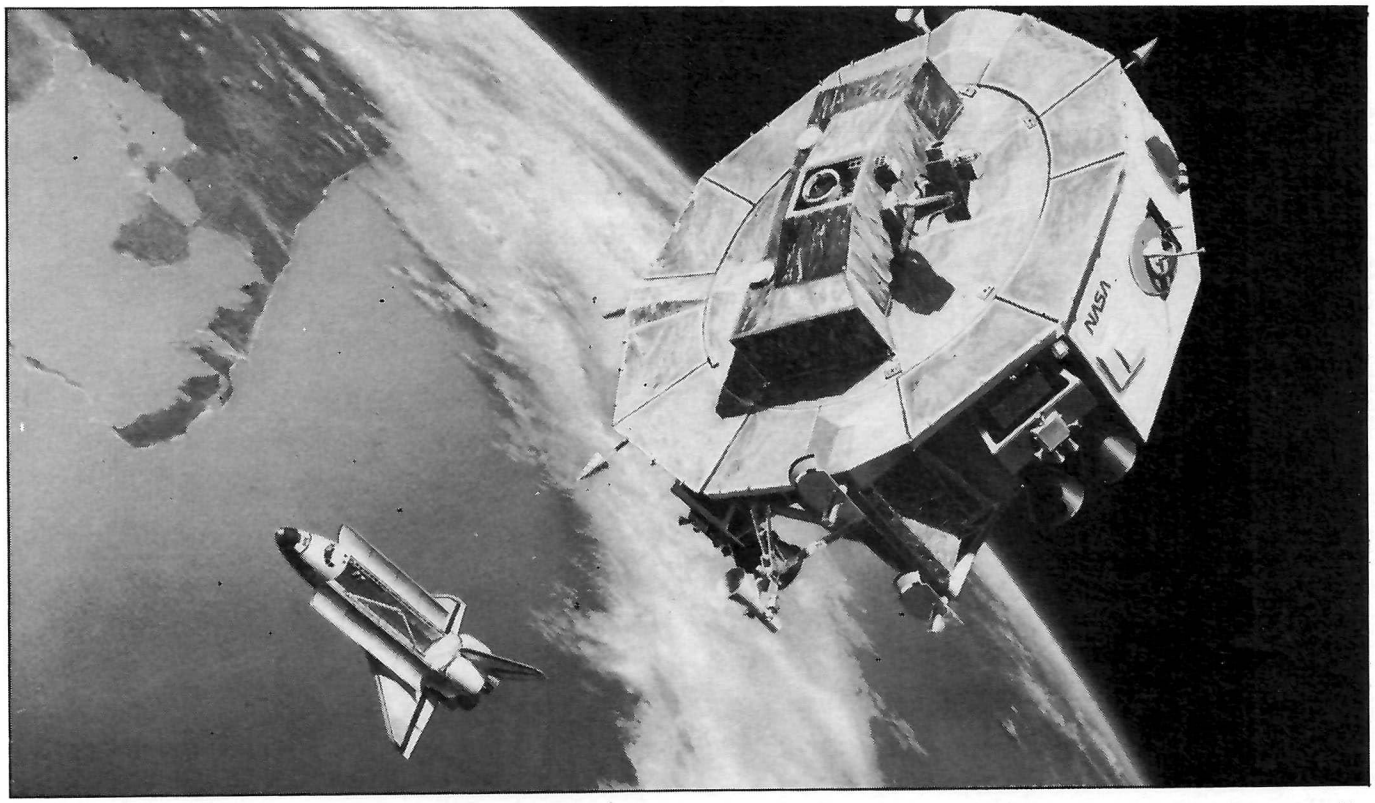
The Space Shuttle has been a monstrously expensive transportation system to develop, but it has given rise to a number of hardware components that can be incorporated into the next generation of space vehicles, cutting their development costs. Although the new vehicles may be unfamiliar as a whole, Shuttle buffs will surely recognise the odd part here and there.



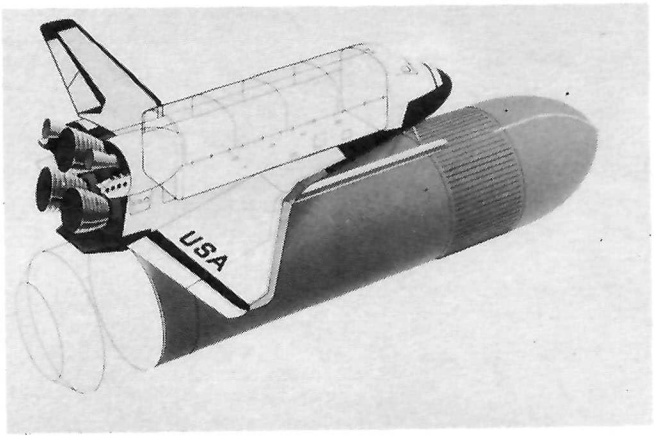
In this artist's impression of a Shuttle-derived cargo vehicle inline I, the thrust of an external tank is boosted by two solid rockets. The tank feeds two Space Shuttle main engines. Photo: Martin Marietta.



Martin Marietta's external tank in service with the space shuttle. Photo: Martin Marietta.



This artist's rendition shows a Boeing Orbital Manoeuvring Vehicle (OMV) after it has left the cargo bay of the Space Shuttle orbiter. As proposed by NASA, this reusable space tug could deliver and retrieve satellites and other payloads beyond the reach of the Shuttle, up to 2,000 nautical miles. The OMV is a modular concept, approximately 15 feet in diameter and four feet in length. It comprises an equipment module containing the avionics and electrical power, a retrieval module containing rendezvous and docking sensors and a propulsion module. Photo: Boeing Aerospace Company.



Vital statistics of the Space Shuttle main engine.

SPACE SHUTTLE MAIN ENGINE (SSME)

Thrust:	
100% power at sea level	1670 kilonewtons (375,000 lbs)
100% power in vacuum	2100 kilonewtons (470,000 lbs)
Throttling ability	65-109% rated power level
Specific impulse (per kilogram of fuel):	
At sea level	356.2 newtons per second
In vacuum	4464.0 newtons per second
Chamber pressure	20,480 kilonewtons per square metre
Mixture ratio (by weight)	6 parts liquid oxygen to one part liquid hydrogen
Area ratio	Nozzle exit to throat area 77.5:1
Weight	3000 kg (6700 lbs)
Life	7.5 hours, 55 starts.

The extraordinary capacity of the Space Shuttle external fuel tank.

SPACE SHUTTLE EXTERNAL TANK (ET)

Total weight:	
Empty	35,425 kg (78,100 lbs)
Gross	756,441 kg (1,667,677 lbs)
Propellant weight:	
Liquid oxygen	616,493 kg
Liquid hydrogen	102,618 kg
Total	1,585,379 kg
Dimensions:	
Liquid oxygen tank	16.3 metres (53.5 ft)
Liquid hydrogen tank	29.6 metres (97 ft)
Intertank	6.9 metres (22.5 ft)

Often ignored in discussions of Space Shuttle propulsion, the solid rocket boosters, providers of the all-important extra kick to orbit.

SOLID ROCKET BOOSTER (SRB)

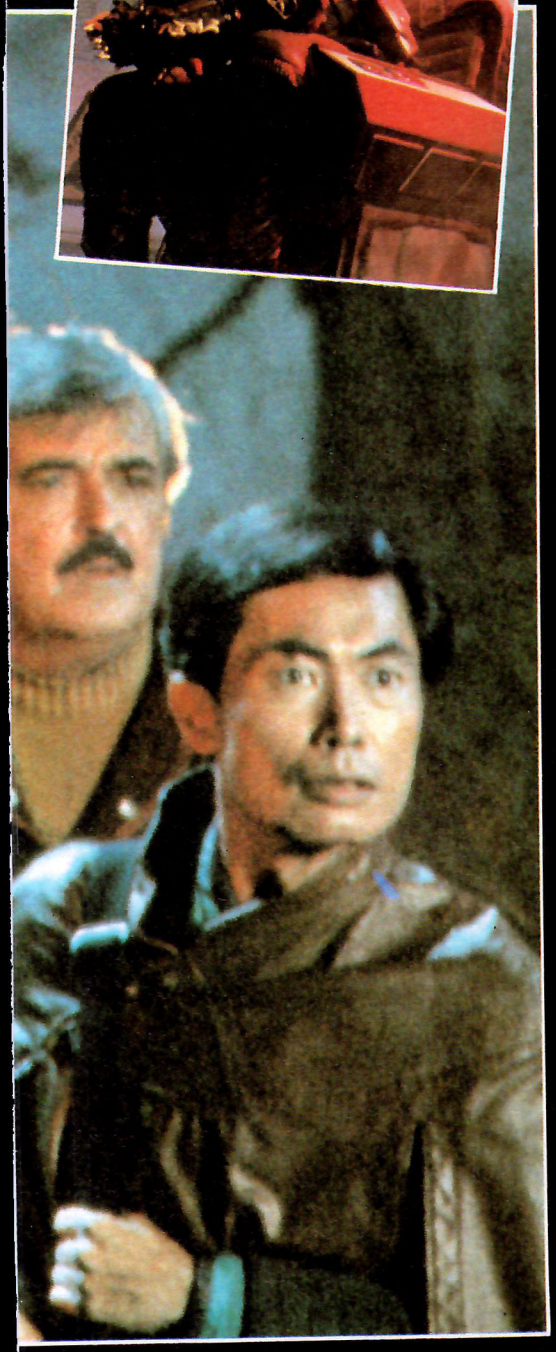
Thrust at lift-off	11,790 kilonewtons (2,650,000 lbs)
Propellant	16.0% atomized aluminium powder 69.8% ammonium perchlorate 0.2% iron oxide powder 12.0% polybutadiene acrylic acid 2.0% epoxy curing agent
Weight:	
Empty	87,550 kg
Propellant	502,125 kg
Gross	589,670 kg

THE SEARCH

STAR TREK III

DON'T READ ON, IF YOU DON'T WANT TO KNOW THE PLOT OF THE LATEST STAR TREK ADVENTURE – THE SEARCH FOR SPOCK. RANDY AND JEAN-MARC LOFFICIER REVIEW STAR TREK III FOR SPACE VOYAGER

I FOR SPOCK



The Search for Spock. 'You know the answer', was alleged to be one of the teaser slogans imagined by the Paramount publicity department. Although this rather unclever teaser was killed in favour of the not particularly inspiring 'Join the Search', the fact remains that the surprise effect, not to mention the dramatic content of the climax, of *Star Trek III* is far less than those of its predecessor, *Star Trek II*.

This should not be, since *Star Trek III* introduces a change even more radical than the death of Spock in the *Star Trek* universe. Something that some fans have said was too awful to contemplate.

The death of the Enterprise

Before dissecting the *Star Trek III* story into a list of pros and cons, and studying its impact on future *Star Trek* picture(s), let us look at the film itself.

The most constant component of a *Star Trek* movie is the cast. On this level, *Star Trek III* deserves a lot of kudos because it contains performances that are superior to those in any of the previous *Star Trek* pictures.

Tension and desperation

William Shatner is . . . well, William Shatner. Those who love him, will find him superb. As to the others . . . this film will certainly not change their minds. There is a feeling of tension, an air of desperation, about Shatner in *Star Trek III* that didn't surface in *Star Trek II*. Possibly, it is because the crisis in this picture cuts closer to the bone. In any event, the man does not play with Kruge in the way he did with Kahn.

At the same time, I was grateful not to be subjected to the sappier, or mushier side of Kirk. There are those who have said that Shatner should have burst into tears as he watched the Enterprise go down in flames. I do not agree. I feel on the contrary that Shatner's barely contained cold rage fits the situation, and the character, much better. One will note that this rage is finally released first in the battle with Kruge (after which Kirk becomes less tense) and then, completely, with the return of Spock.

Nimoy is barely present in the film, and his youthful surrogates (shades of *Doctor Who*!) do not have to act in any meaningful sense. So, on to DeForest Kelley who is truly superb and, frankly, steals the show. He is in turn ominous (the scene in Spock's quarters), desperate (in the bar scene), funny, touching, etc . . . The fact that he has some of the best lines in the film does not hurt either. Rumours have it that McCoy's character will be further developed in *Star Trek IV*, which is only justice. I can't wait.

This time around, Koenig (Chekov) has little to do, but Nichelle Nichols's Uhura and George Takei's Sulu each have their moments of glory

Left: A planet-bound scouting party prepares for action. Photo: John Shannon. *Above Left: The enemy forces plan their onslaught. Below: The adversaries close on one another. The OK Corral is alive and well and living in Trekdom.* Photo: Industrial Light & Magic.
All Photos © 1984 Paramount Pictures Corporation

– and what moments these be! Uhura has *the* best line in the film. Realistically, little more can be achieved with these characters in the space of a 100-minute movie, yet what a satisfaction to see them in action again. The same basically holds true of Jimmy Doohan as Scotty, although he is on the screen a bit longer.

Wasted potential

Merritt Butrick (David Marcus, Kirk's son) is, here, much better than he was in *Star Trek II*. It makes his callous death at the hand of a Klingon quite a loss to the future of the series. Marcus's character had potential, which has been sorely wasted. Robin Curtis, who took over the role of Saavik from Kirstie Alley, both looks and handles the character differently

The Vulcans are coming! An Enterprising crew member. **Photo: © 1984 Paramount Picture Corporation.**

Mark Lenard is Sark, Spock's Vulcan father. **Photo: © 1984 Paramount Picture Corporation.**

than Alley. Fans will probably argue over which one is better, but I confess I found Curtis perfectly adequate in the film.

Then, there are two other stars, who are also best known for their television performances. It seems curious that Paramount chooses mostly television actors for the *Star Trek* pictures. No matter. James B. Sikking plays Captain Styles, commander of the USS Excelsior, a souped-up version of the Enterprise. And Christopher Lloyd is the villainous Klingon Commander Kruge. The strange thing about these two is that they portray their *Star Trek* characters in a style which is amazingly similar to their regular characters in their own TV series.

For instance, Sikking is the buffoonish Howard Hunter in *Hill Street Blues*, and plays Styles very much in the same way, for our pleasure I must hurry to add. On the other hand, to see Kruge act like the brain-devastated Reverend Jim of *Taxi*, complete with New York accent, is quite a shock. Fans of the TV show will have a lot of difficulty in accepting Christopher Lloyd, and, the fact that he is the major villain of the piece makes it even more of a problem. This is a serious casting flaw.

Bones makes Z's as the Admiral gets set for a rude awakening. Photo: John Shannon.
© 1984 Paramount Picture Corporation.

Nimoy's direction

Technically, *Star Trek III* also has a few problems . . . To begin at the beginning, Leonard Nimoy is not a bad director, but neither is he a good director. Wise had vision, a sense of epic-ness. Meyer kept his camera moving, generating a lot of excitement. Nimoy just films, competently, but without a great deal of imagination. When the film succeeds, it is because of its actors or its script, not really because of inspired direction. There are a number of shots 'missing' in the film, ie: shots that would have improved the picture's dramatic content. For example, the fact that there are only Kirk and his four companions on board of the Enterprise is never emphasised (a few shots of dramatically empty corridors would have helped), etc.

The relatively dull, or dark, photography does not help either. Meyer kept *Star Trek II* shining, so to speak. *Star Trek III* is visually unexciting. The film looks, in fact, older than its predecessor. The feeling that you're looking at a 'studio' film of the 1930s or 1940s is somehow emphasised by some of the sets that really look like . . . sets, the costumes and the Tom Burman make-ups, which somehow never quite look realistic. The bar scene and the final scenes on Vulcan could have come straight out of *Flash Gordon Conquers the Universe*.

But . . .

On the good side of things, Lucasfilm did their usually outstanding job on the space sequences. The Enterprise docking at the space station is a beautiful piece of film. The cloaking device is another well-rendered effect. Some of the new models, however, such as the Klingon Bird of Prey or the Merchanter ship have a very 'modelly' look to them.

Lastly, James Horner's musical score is adequate, but inferior to that of *Star Trek II*. I noticed bits and pieces of Holst's 'Planets', which seems to be the rip-off score of the year (eg: *The Right Stuff*).

If *Star Trek III* can be said to be somewhat of a disappointment from a technical standpoint, it is a further conceptual breakthrough in terms of story.

But before coming to that, let me quibble over a few details. First, why – with all of the importance of Genesis, and the hijacking of the Enterprise – didn't the Federation send another ship to investigate? *Return of the Jedi* has demonstrated that you can have more than two spaceships in action together, a fact which, so far, *Star Trek* has continued to ignore.

Also, as mentioned above, Marcus's death seems a bit gratuitous, although I suppose it helps in explaining why, after that, an obviously guilty Kirk no longer hesitates to sacrifice the Enterprise.

Change of focus

The loss of the Enterprise is a clear signal that the new guiding hand of *Star Trek*, Harve Bennett, has firmly changed the focus of the film series, while I believe, retaining much of the flavour of the original television series.

Star Trek was charming because it could be touching, funny and thoroughly entertaining, even if it was a bit poky or pretentious at times. I don't think anybody will dispute the fact that, overall, the films have managed to guard that feeling. On the other hand, because of its

episodic nature, the focus of the TV series was very much on the 'voyages of the starship Enterprise'.

This is no longer true.

Many have said that the true hero of *Star Trek*, the TV series, was in fact the Enterprise. Often described as Kirk's 'mistress', she was certainly an obsession with both the characters and the writers of the show. In fact, how otherwise to explain that Kirk never married, and ignored his son for most of his life, if not for the important place that the Enterprise held in his life?

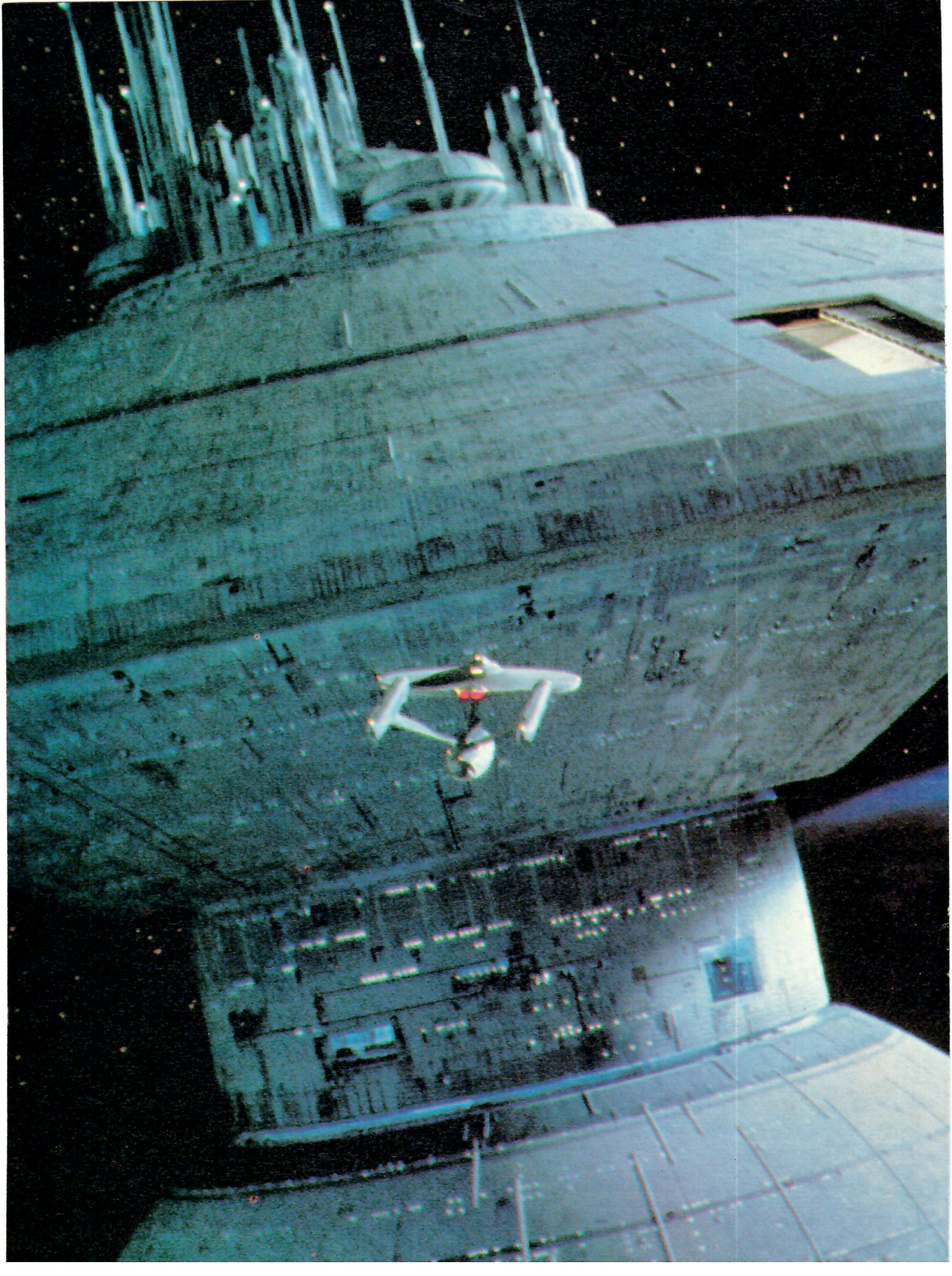
The first film tried to maintain this 'voyage' aspect – and failed. One had to recognise that, as *Star Trek* changed media, its focus had to change too. The actors were older. How long could Starfleet logically leave them in charge of the Enterprise? How many ways could the writers devise for Kirk and his group to once more be at the helm (count them so far: desperate mission, training mission, pure and simple hi-jacking)? The financial rewards of each movie grow greater, and so does the clout of the stars.

What now?

For all these reasons, and more, *Star Trek* is no longer the story of the 'voyages' of the starship Enterprise, but that of a group of battle-scarred veterans, who are 'the best there is'. How will this tight group of aging but outstanding pros survive in the harsh, technological universe of the Federation? That is the question, now. Will they rent themselves as a mercenary cadre, like Gordon R Rickson's 'Dorsai'? Will they be soldiers of fortune, returning to save Earth from an even greater danger than V'Ger? And, some day, will they just sail away like Arthur, Conan, or Long John Silver into the Great Beyond?

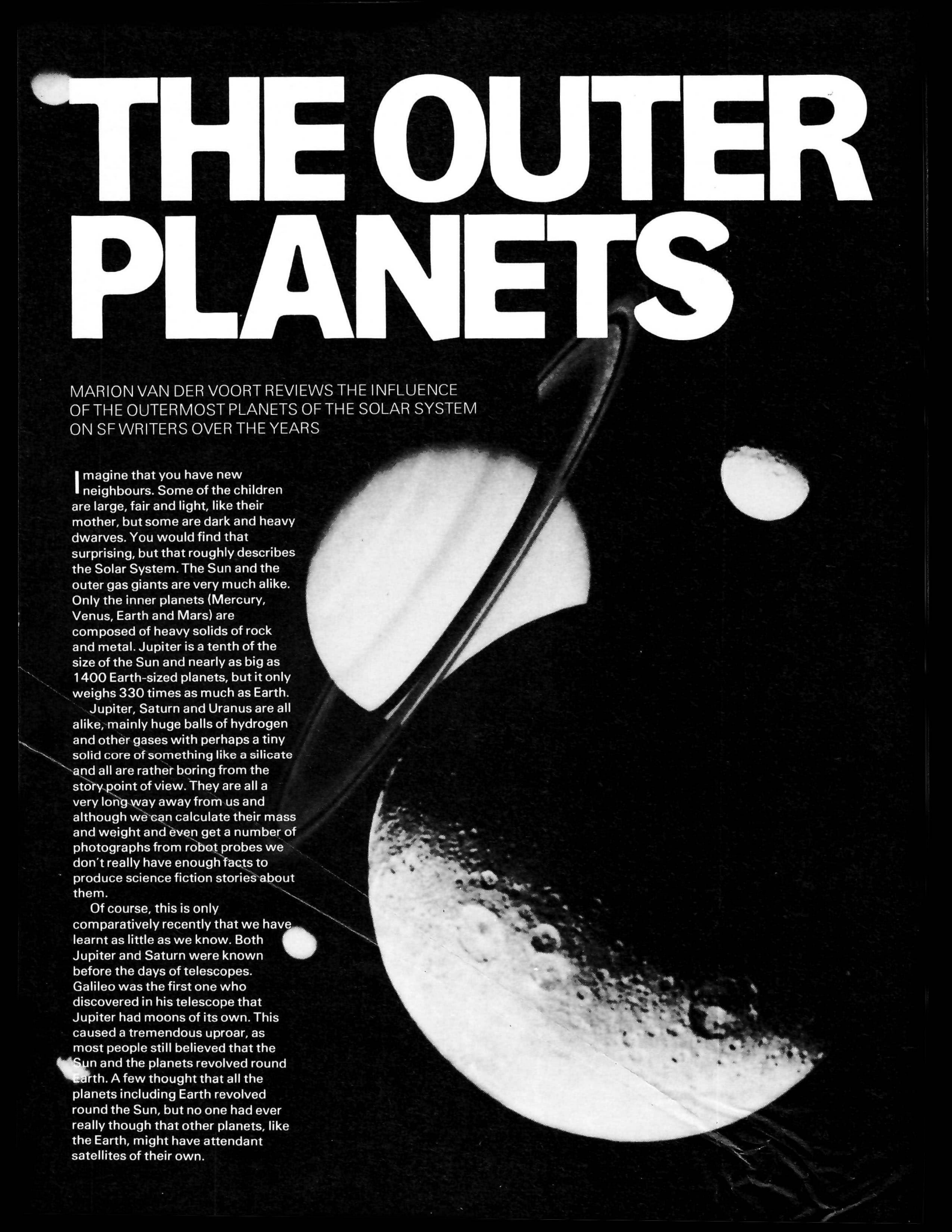
Admiral Kirk plays back a sequence from the ship's computer. Photo: John Shannon. © 1984 Paramount Pictures.

Shock, horror, gasp! The truth is out! The Klingons are in fact under the control of the Pittsburgh Public Theatre. Photo: John Shannon. © 1984 Paramount Picture Corporation.



THE OUTER PLANETS

MARION VAN DER VOORT REVIEWS THE INFLUENCE OF THE OUTERMOST PLANETS OF THE SOLAR SYSTEM ON SF WRITERS OVER THE YEARS



Imagine that you have new neighbours. Some of the children are large, fair and light, like their mother, but some are dark and heavy dwarves. You would find that surprising, but that roughly describes the Solar System. The Sun and the outer gas giants are very much alike. Only the inner planets (Mercury, Venus, Earth and Mars) are composed of heavy solids of rock and metal. Jupiter is a tenth of the size of the Sun and nearly as big as 1400 Earth-sized planets, but it only weighs 330 times as much as Earth.

Jupiter, Saturn and Uranus are all alike, mainly huge balls of hydrogen and other gases with perhaps a tiny solid core of something like a silicate and all are rather boring from the story point of view. They are all a very long way away from us and although we can calculate their mass and weight and even get a number of photographs from robot probes we don't really have enough facts to produce science fiction stories about them.

Of course, this is only comparatively recently that we have learnt as little as we know. Both Jupiter and Saturn were known before the days of telescopes. Galileo was the first one who discovered in his telescope that Jupiter had moons of its own. This caused a tremendous uproar, as most people still believed that the Sun and the planets revolved round Earth. A few thought that all the planets including Earth revolved round the Sun, but no one had ever really though that other planets, like the Earth, might have attendant satellites of their own.

The Jupiter effect

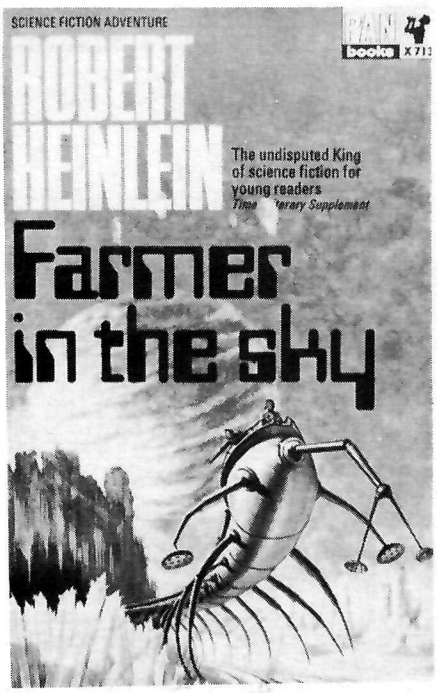
The SF writers of the 1950s described Jupiter as having a rocky core, like Earth, but covered with a deep, turbulent atmosphere that was quite unsuitable for men, yet starting from the same basics they produced quite different stories.

In 1954, Clifford D Simak, in a book called *City,* imagined a base on Jupiter, heavily shielded against the poisonous atmosphere and the bone-crushing pressure. As it was impossible for men as such to brave the outside, they have carefully transformed them to the native Lopers and sent them out to explore. But none of them had come back. We learn that they don't come back because the human body is so frail and limited and that the men preferred being Lopers, never having to eat or sleep and using many mental abilities unknown to humanity. In Loper bodies Jupiter is not terrible but beautiful. Eventually one Loper returns and the rest of humanity learns the truth and gives up civilisation to be Lopers on Jupiter.

In contrast, Poul Anderson wrote a story in 1957 entitled *Call Me Joe* in which Jupiter is again harsh with ice mountains, hydrogen geysers, methane waterfalls and sodium explosions. It has a range of life forms that are ferocious and tough, but of limited intelligence. Men create a lifeform that can fit into this background, a feline centaur with a thick prehensile tail, who can drink methane and eat the native flesh. He is controlled by a crippled Earthman from Jupiter V and learns to cast axes and other tools from ice, builds a shelter, kills the local predators and generally enjoys himself.

James Blish describes yet another Jupiter in *They shall have Stars,* the first volume of his *Cities In Flight* series published in 1956. His Jupiter is bitterly cold and mankind, through robots, is building a bridge of Ice IV, water frozen under great pressure to be almost unbreakable. The Bridge is 30 miles high, 11 miles wide and 54 miles long, but progress is very slow.

One other story must be mentioned, *Victory Unintentional* by Isaac Asimov, in *The Rest of The Robots,* for its humour alone. The inhabitants of Jupiter are very tough and ferocious and they intend to wipe out all non-Jovians wherever they find them. Men decide to send ambassadors down to speak to them and finally three robots go down to represent humanity, who demoralise the Jovians entirely.



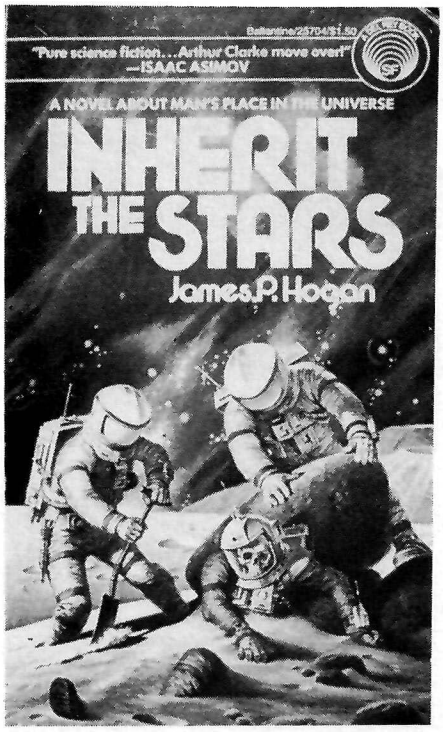
Neptune's legacy

Jupiter is the biggest of the gas giants, in fact it contains nearly seventy per cent of the mass of all the planets combined, and Saturn and Uranus are just smaller copies, so let's go out farther and look at Neptune. From the little that we know, it is possible that Neptune does have a rocky core, so Olaf Stapledon's *Last and First Men* might have been logical when he postulated mankind's removal to Neptune when tragedy strikes the Solar System. A large volume of non-luminous gas (his description) drives through the Solar System, engulfs Saturn, Earth and Venus and finally strikes the Sun, making it almost as large as Mercury's orbit. Mankind hurriedly redesigns itself yet again, and moves the Ninth Men to Neptune. But they are far too delicate to survive as Neptune is actively volcanic with an unwholesome atmosphere and equatorial regions so hot that any life is impossible there. Gradually they sink from barbarism through sub-humanity to beasts and stay that way for about three hundred million years. Then they start creeping up in intelligence and ability until after another hundred million years the full flower of humanity, the Eighteenth Men, appear, only to face failure when local stars, including our Sun, run amok.

Let's look at the Asteroid System and Pluto now. One is mainly between the orbits of Mars and Jupiter and the other pursues an untidy orbit around the fringes of the Solar System, yet both are often mentioned together in science fiction. As usual we know very little yet about either. Originally it was thought that there should be another planet between Mars and Jupiter, but only very small planetoids have been found. It may be that when the solar system was forming they just did not coalesce into a planet, or, as some writers have suggested, a planet once existed there, but then disintegrated.

Planetoid plundering

Robert A Heinlein, in *Space cadet* and *Space Family Stone,* suggests that it was called Lucifer and the Luciferians destroyed it accidently by an uncontrolled nuclear explosion. This means that some of the asteroids are made of core material, very heavy, with expensive metals and even some gravity. There are swarms of miners, as in the old American gold strikes, each hoping to make a fortune, some loners, or in small groups with a minimum of equipment and shelter, served by one small trader. Some of Larry Niven's stories also mention asteroid miners. James P Hogan in *Inherit The Stars* postulates a planet called Minerva, which is inhabited by a high civilisation, yet the planet is growing more and more uninhabitable, partly owing to the cold, and partly due to the rise of carbon dioxide. In despair they try importing animals and subhumans from the primitive Earth, then give up and move out of the solar system. The ex-Terrans grow more civilised, turn to war, and eventually destroy Minerva. A fragment flies out to become Pluto, the moon flies free, and the survivors on the moon finally end up somewhere else.


"Pure science fiction...Arthur Clarke move over!"
—ISAAC ASIMOV
A NOVEL ABOUT MAN'S PLACE IN THE UNIVERSE
INHERIT THE STARS
James P. Hogan

Outpost Pluto

Pluto seems now to be mainly ice, by its weight and mass, but in older times, several writers suggested that it might be habitable. Clifford D Simak, in *Cosmic Engineers* in 1939, has the charming idea of a highly civilised race who find that their solar system is crashing into our sun, as yet without planets. They take to spaceships, can find no nearby planets, and eventually come back to our Sun, to discover that their late fourth planet is now our Pluto. They manage to survive there for a while and spread spores of their life through the Solar System. They finally die off, leaving only their robots around to meet the descendants of their spores three billion years later.

E E (Doc) Smith in *First Lensman* in 1950, mentions that Pluto has been colonised by the Palainian, cold-blooded, with an extension into hyper-space to enable them to survive without heat, light or oxygen, and a fluid and amorphous three-dimensional image.

Each of these stories are based on the old assumption that planets are formed by accident, and rare, but we think now that planets are fairly common. Equally common are satellite systems around the larger planets in particular, and the moons of gas giants have been fruitful for writers. Jupiter in particular has several small moons and a thin ring system. The most likely of its moons is Ganymede. The main problem is heat. All the gas giants are a long way out from the Sun. Jupiter gets little more than a thirtieth of the heat that we receive on earth and Ganymede is in synchronous orbit, like our Moon. It has one face fixed permanently towards Jupiter, so a Ganymede day is the equivalent of our week and the moon will have 84 hours of daylight, than 84 hours of darkness. Yet Ganymede could still be made suitable for human life, if it has the rocky core that we suspect. Robert A Heinlein described how it could be done in *Farmer In The Sky* in 1950.

First an artificial method of heat would be needed to melt the ice, then the water would

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Letter from Hollywood

RANDY AND JEAN-MARC LOFFICIER REPORT ON THE LATEST NEWS AND VIEWS FROM THE HUB OF THE FILM WORLD

The long-awaited *Dune* project is approaching completion. US release is scheduled for Christmas of this year. During a recent visit to the production offices, director David Lynch was busy working on the sound mixing. Loud, impassioned screams from the sound-track found their way into producer Raffaella De Laurenttis' office, causing all present to jump in shock.

The optical effects are being handled by Van Der Veer Technical Effects (the company responsible for the effects in the *Star Trek* television series) and Carlo Rambaldi (*E.T.*).

Shot more or less simultaneously with *Conan II* at the Churubusco Studios in Mexico City, *Dune* stars Francesca Annis, as Lady Jessica; Jurgen Prochnow as Duke Leto; Max Von Sydow as Ecologist Kynes and Kenneth MacMillan as Baron Harkonnen. A young, unknown actor from Washington state, Kyle MacLachlan, plays the part of the hero, Paul Atreides. Rock star Sting has the role of Feyd Rautha.

Lynch told us that rock group Toto was in the process of composing the musical score. Whatever the score, *Dune* is going to have to please a lot of fans around the world!

The Clan Of The Cave Bear

After several false starts, Jean M Auel's best-selling novels, *The Clan of the Cave Bear* and *The Valley of Horses* are making their way to the silver screen. Being shot back-to-back starting in June of this year, the films will be directed by Michael Chapman, and the screenplays have been written by John Sayles, who wrote *The Howling* and *Piranha*, and wrote and directed *Return of the Secaucus Seven*.

Darryl Hannah, from *Splash* and *Blade Runner*, has been signed to play the role of Ayla, a Cro-Magnon cavewoman who is beautiful by our standards, but not by her people's (they are Neanderthals). After being cast out by her clan, she becomes the leader of a new people . . .

Originally, the project was scheduled to be an NBC miniseries, but it was decided that it would be better served as a feature film. Auel, in the meantime, is at work on the third volume of the series, *The Mammoth Hunters*.

Hyper Sapien

Hyper Sapien is an $18 million film, produced by Jack Schwarzman (*Never Say Never Again*) and directed by Michael Wadleigh (*Wolfen*). Principal photography is set to begin in October, 1984 and the US release is scheduled for summer, 1985.

Two species of aliens, the Hyper Sapiens and the Trilats, are busily studying a doomed race called Humans, when three of the alien youngsters stowaway on an Earthbound ship. The adult aliens try to find the mischievous youngsters before they're discovered and killed, or before the powerful, young Tilat does something to destroy the planet. The adults are not particularly successful in their search, and the child-aliens become involved in many Earthly adventures – including falling in love with an Earth boy!

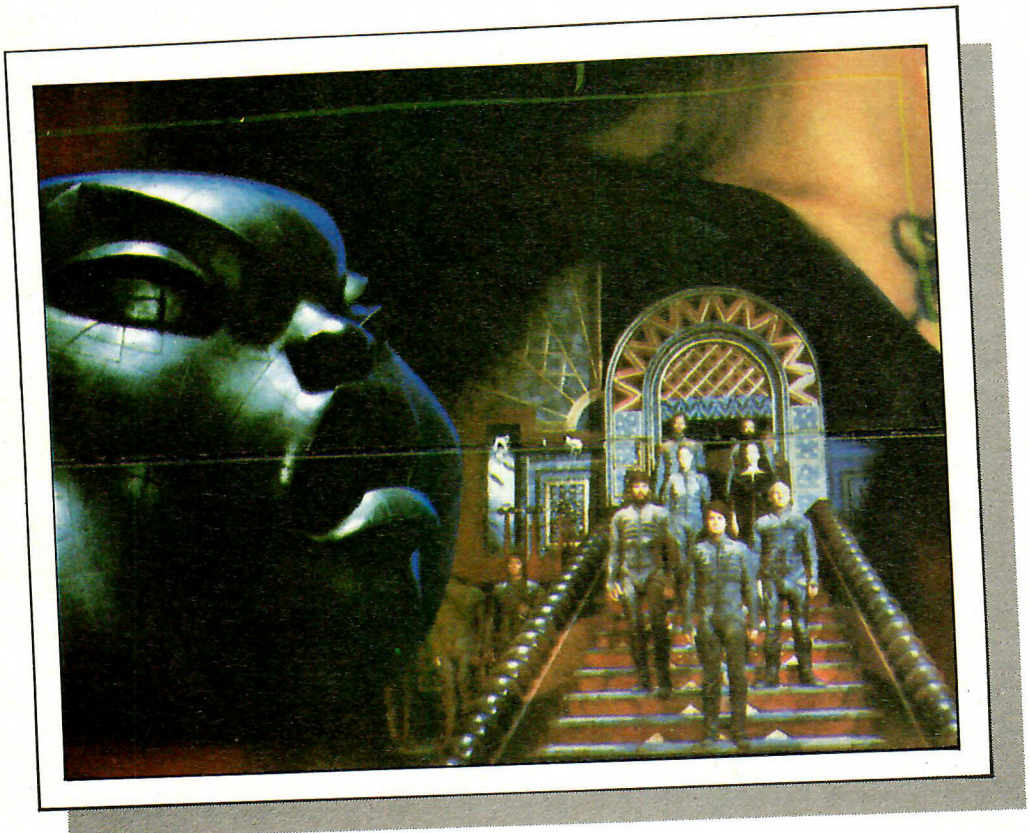
An impressive crew of technicians has been assembled for the film, including, director of photography, Stephen Goldblatt (*The Hunger*); production designer, Harry Lange (*The Dark Crystal*); and special effects director, Colin Chilvers (*Superman II*). Alien creatures will be created by Rodger Shaw, who served as chief special effects technician on *Greystoke*. Kevin O'Neal, who worked on such *2000 A.D.* strips as *Nemesis* and *The A.B.C. Warriors*, is credited as conceptual artist.

Short takes

Patrick McGoohan (*The Prisoner*), William Katt (*The Greatest American Hero*) and Sean Young (*Blade Runner*) star as two opposing teams of explorers who discover a baby brontosaurus in an uncharted region of Africa. At this writing, the original title of this Disney production, *Baby*, was being changed, possibly to *Wild Thing*.

The film was directed by Bill Norton *More American Graffiti*, and the lovable brontosaurus was created by master special effects wizard, Isadoro Raponi (*King Kong, Close Encounters of the Third Kind*). The film's producer, Jonathan Taplin, is so happy at Disney, that he's staying on to produce his next film, *My Science Project*, scripted and directed by Jonathan Betuel, who wrote *The Last Starfighter*.

Prolific producer Dino De Laurenttis has announced plans to do a remake of *20,000 Leagues Under the Sea*. Fans should not hold their breaths waiting for its release. Also on the Jules Verne trail, *Around the World in 80 Days* is being remade as an eight-hour television miniseries for NBC. Cost is budgeted at $24 million.



Due out in America around Christmas time is David Lynch directed film of the classic S-F book, Dune.

Not to change the subject from De Laurenttis, the producer's schedule is replete with genre films. Titles include: Robert E Howard's *Red Sonja*, directed by Richard Fleischer (*Conan II, Fantastic Voyage*); *Cat's Eye*, a Drew Barrymore starrer, specially scripted by Stephen King, to be directed by Lewis Teague (*Cujo*); *Total Recall*, a Ron Shusett/Dan O'Bannon (*Alien*) script, directed by David Cronenberg *The Dead Zone*; and David Lynch's long-awaited new project, *Ronnie Rocket*, a film about aliens and 60-cycle electrical current!

The $18 million science fiction epic, *Enemy Mine*, had a change of director, as Richard Loncraine left after three weeks of filming in Iceland, citing the everpresent reason, 'creative differences'. He was replaced by German director, Wolfgang Petersen (*Das Boot, The Never Ending Story*), who moved the production to Hungary.

Fraser Heston, son of actor Charlton Heston, has written and will direct a film called *The Overlord*, which will star daddy Charlton (with whom he did *Mother Lode*). Set in the time of the Trojan War, film tells the tale of a battle between a Bronze Age king, Aegeus (Heston), and a Scythian barbarian, Creon, on the steppes of the Black Sea.

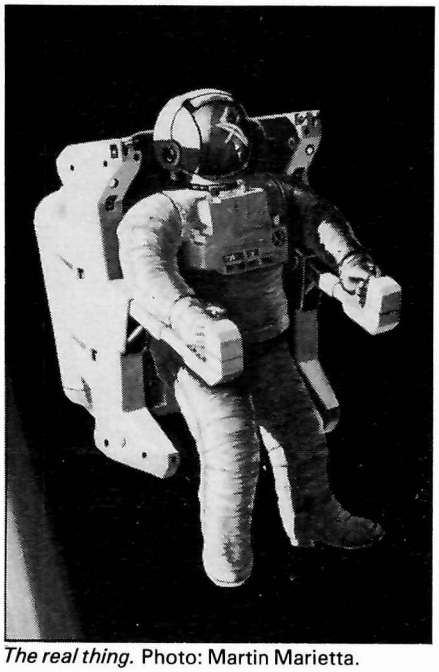
Ron Howard, fresh from his success with *Splash*, will direct a $13 million SF production, *Cocoon*, for Twentieth Century Fox. The film deals with aliens, Atlantis and a search for home.

Above: Sean Young of Blade Runner fame is to appear in a Disney film co-starring with a baby dinosaur! Above left: Mischievous young aliens on Earth is the story line behind 'Hyper Sapien'.

Left: Sting takes time off from Police duty to play Feyd Rautha in the long awaited film of Dune.

BUILDING NASA's MMU

JUST BECAUSE THE KIT MANUFACTURERS HAVEN'T ISSUED A KIT OF SOMETHING, THAT'S NO REASON NOT TO BUILD IT WENDY INGLE TACKLES NASA'S MMU



The real thing. Photo: Martin Marietta.

This model of Bruce McCandless on his first 'solo' flight is made from a Tamiya 1/25 scale figure. A kit in a standing pose would probably be best for this conversion, but as you are likely to have to use whatever your local supplier has in stock I did likewise and used the German Machine Gunner.

Before beginning the conversion, if it is your first, look up some anatomy, or figure drawing, or just watch people around you; so you have clear in your mind's eye how joints articulate before you begin to cut. A leg does not hinge at the very front, or back, but at a point within the thickness of the knee. Get it wrong and you distort the length of the limb.

The first step is to separate the legs at the crutch and recement them so that the thighs are parallel. The mess this makes of the waist does not matter – it will be buried in putty later – just make a new flat top for the body to sit upright on.

The right leg is bent as I wanted it, but the left knee and right ankle need to be broken and reset so that both legs almost match. These joints are rather weak and need pinning with a short length of wire. A heated pin will make the holes, but a pin vice with a fine drill bit is better. The right arm needs to be attached so that the elbow is lifted almost at a right angle. Slice 3-4 mm from the top of the arm and cement it with a wedge of plastic scrap in the armpit.

The left arm needs too much alteration. I replaced it with a corner from the sprue (the waste plastic to which the kit parts are attached). Check the length carefully against the other arm and cement it on at the same height and angle. This joint to needs pinning. The hand is from the spares box. The kit hand could be used at a pinch, but would need fingers added.

Headless astronaut

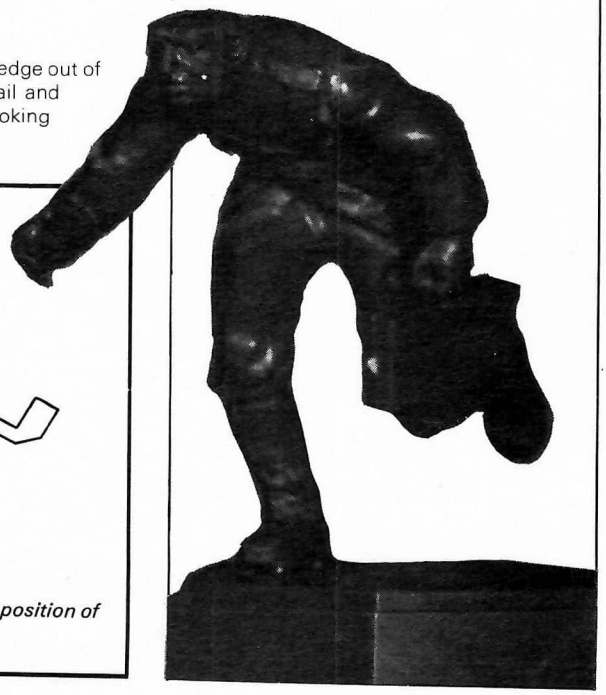
Next – decapitate him. Take a wedge out of the neck, remove all collar detail and replace the head. It must be looking straight ahead when the body is upright. Add the legs. This completes the conversion of the basic figure. Leave it to dry thoroughly before the next stage.

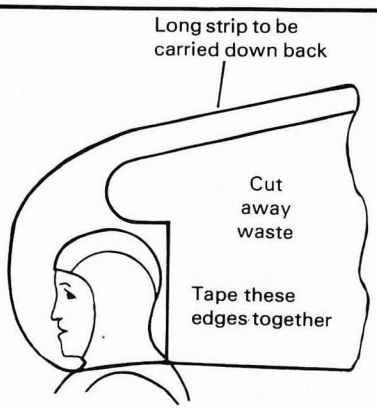
There is a tendency to under-do the padding for the EMU (Extravehicular Mobility Unit – or Spacesuit!), so for now just give the figure a preliminary thick, smooth, covering of Milliput all over. This is the time to make the puny left arm match the right.

Use the helmet chin strap as the edge of his balaclava and carry it on round the brow. Build up the top of his head smoothly. When the Milliput is cured (set) the head can be painted. The balaclava is black with a broad white stripe over the top. Carry on the black to cover all the neck and shoulders which will be inside the helmet.

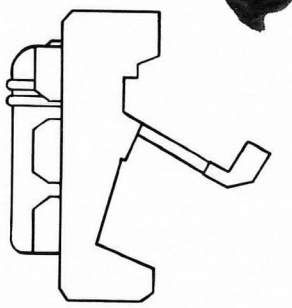
For the microphone, strip all but the last 2 mm of plastic sheathing from a length of fine wire, and cement it to his left shoulder with the thick end by his chin. Paint it matt black. The face, with its open mouth, I thought looked rather startled when painted – but then why shouldn't he?

Unmodified German machine gunner – the starting point for Wendy Ingle's astronaut.





Fitting the visor.



Side view of the MMU including position of tanks and control arm.

Helmet hunting

Now to the helmet. This is where you'll wish you hadn't started. A lengthy tour of the shopping centre convinced me that the best material for the visor is the plastic packaging on Boots feeding bottle teats. The pack of three has the best shaped dome, and means you can have three shots at getting it right!

Cut away one complete dome. Paint the inside, very sparsely, with Humbrol copper, preferably only partly stirred. Keep brushing until the paint is all but dry and you'll find the brush marks will work out. This colouring is to represent the polaroid effect of the visor.

Trim the cut away part to sit neatly at the figure's throat. Build up a little collar of Milliput to bed it on to. Then cut the waste away so that the two sides extend slightly beyond the back of his head, and there is a narrow strip at the top (Fig 1). Pass a small strip of sellotape across the back of his head so that the sides of the visor are pulled together just slightly. Then carry the strip from the top down and cement it to his back (*not* the back of his head). Allow it to dry.

Roll two thin sausages of Milliput and lay them across the visor to define the top and bottom edges of the helmet. You might find it helpful to mark in the lines with paint first – of a type that will wipe off in case of error.

Fix a piece of thin plywood, or thick plastic sheet, approx 3 x 2 cm to his back as the basis for the EMU tank. Add rounded top and sides to this in the same operation as building up the rest of the helmet – Milliput again. All of this life support system is protected by fabric, so give it soft edges. Only the front panel of the helmet is rigid, and so is made from plasticard. Take care not to force putty into the back of the helmet through the gaps left by the visor's plastic. Leave the back of the EMU tank bare for attaching to the MMU.

Scale drawing

We know the dimensions of the MMU (Manned Manoeuvring Unit), to whit; 125.4 cm high, 82.7 cm wide (the back), and 120.9 cm deep with hand controllers fully extended. From these, all the other dimensions can be worked out from the photographs which have been widely published – taking care that relative dimensions are not distorted by perspective.

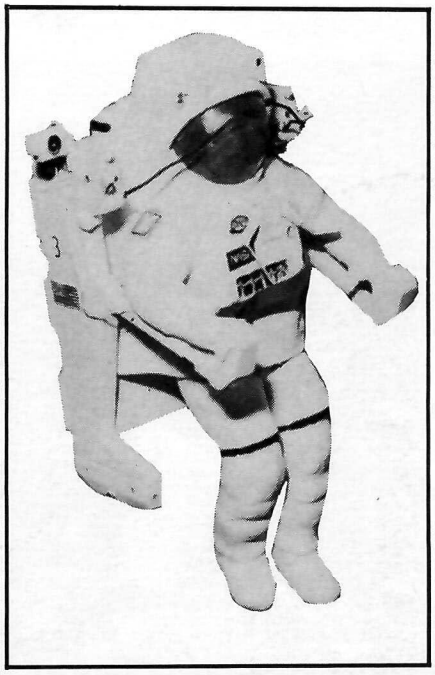
Draw a side view of the MMU (Fig 2). Trace the side panel only (not the arms) onto thick plastic sheet and cut two. If you cannot find sheet thick enough, thinner sheet can be 'welded' by liberal but careful application of cement.

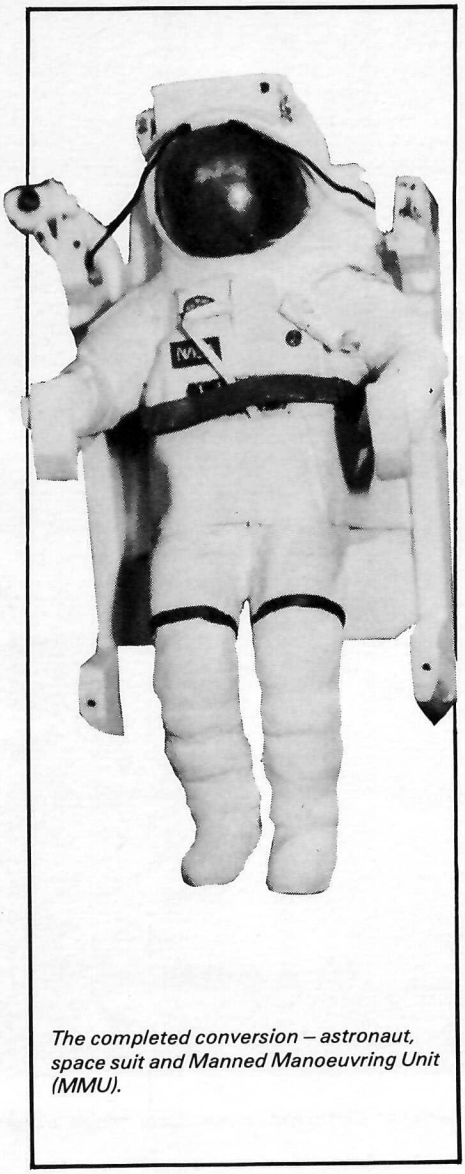
The tanks which fuel the MMU need to be 3.1 cm x 1.0 cm. Make two rolls of paper, slightly shorter than this to allow later for the curvature at top and bottom, and attach them to another piece of plywood 3.2 x 2.9 cm. Lay another piece of paper loosely over the tanks to represent the overwrap. Attach the side panels, consulting the drawing to check the relative positions of all these sections. Finish off top and bottom of the unit with Milliput. Drill in the 24 thrusters – four at front, back, both sides, top and bottom.

Padding out

By offering the figure to the MMU you can now estimate how much more padding he needs. Cover him again with putty, not forgetting the soles of his boots, and covering as far as the first finger joint on his hands. Check with photos to see how the suit creases.

During this operation you should add a plasticard shape for the toolkit on his chest. The metal section at the bottom of this – whatever it might be – is made from the aluminium mesh sold for use with Plastic Padding. Its diamond shaped holes are easily pulled into the square shape required here. When you're happy with EMU and MMU cement them together. Then you can add the control arms made from plasticard and sprue. I could find no clear pictures of the controls themselves, so I left them out. You might care to guess – or follow suit.





The completed conversion – astronaut, space suit and Manned Manoeuvring Unit (MMU).

Fit a strip of lead foil, which moulds nicely to the body, around the astronaut's middle. This holds him in his flying armchair. Other straps etc are also made from lead foil, or good paper.

I don't know what those black things are in front of his face, but they're in the photos, so have to be made. Again, they are stripped wire with a short length of sheathing left on. Add the camera (sprue again) with its long wire to the control arm.

Painting points

He's painted all over in several coats of Humbrol white matt, with creases shadowed in a very light grey. The badges were all painted onto thin paper then stuck in place. The red NASA on his chest was made by painting plain red onto plasticard, then scraping in the lettering. The No 3 is Letraset.

You might begin to regret he's American when you get to the Stars and Stripes. If you can find suitable transfers by all means use them. I found it best to paint the blue section solid, then peck out white specks with a very fine point. I defy anyone to count them at this scale. The inside of the camera lens is painted with a mix of black, silver and varnish. The insides of the thrusters are picked out in the same.

This makes a very heavy model which nevertheless must hover above its stand. I fixed a sewing needle (long, fine, but still strong) deep into his heel; the other end supported in Milliput inside the stand. The stand is two lids, the bottom one very wide for stability.

If you're still with me you now have a fair representation of the first man to hurtle alone around the Earth at 17,000 mph.

IMAI ROBOT

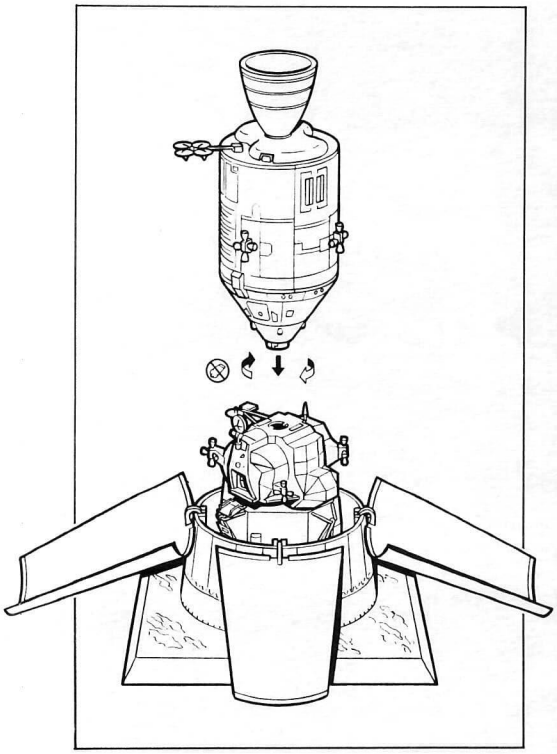
An object lesson in careful construction and photography – Fraser Gray's Imai Robot. Model and photo: Fraser Gray.

APOLLO LUNAR SPACECRAFT

IAN GRAHAM BUILDS THE REVELL APOLLO HISTORY MAKER

On May 25th, 1961, President John F Kennedy committed the United States to a manned landing on the moon by the end of that decade. The hardware, manoeuvres and operational skills necessary to achieve that goal were developed through the one-man Mercury and two-man Gemini programmes, culminating in a manned Apollo landing in the summer of 1969.

The Apollo spacecraft and launch system



were the brainchild of a team of German scientists who had developed devastating rocket-powered weapons during the second World War at their research station near the village of Peenemunde on the Baltic coast. Their project leader, Wernher von Braun, had joined the German amateur rocket group, VFR (Verein fur Raumschiffart), in 1930. A group of army officers became increasingly interested in the small experimental rockets that he and his colleagues were designing and firing. Before long, their work attracted military backing and eventually von Braun found himself at Peenemunde.

Two kits in one

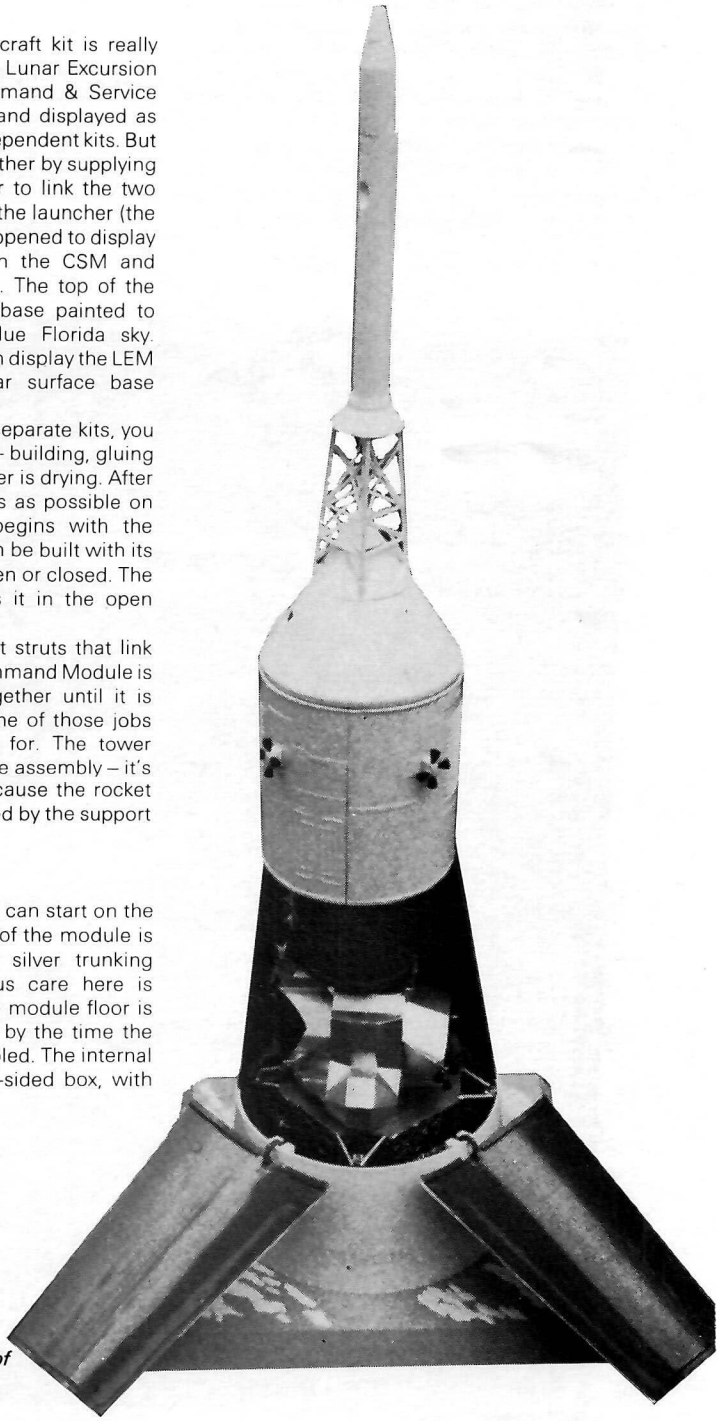
Revell's Apollo Lunar Spacecraft kit is really two kits in one package. The Lunar Excursion Module (LEM) and the Command & Service Module (CSM) can be built and displayed as two entirely separate and independent kits. But Revell have gone one step further by supplying the top of a Saturn launcher to link the two models together. The side of the launcher (the LEM shroud) can be partially opened to display the LEM stowed inside with the CSM and launch escape tower on top. The top of the launcher is displayed on a base painted to simulate a cloud-flecked blue Florida sky. However, if you prefer, you can display the LEM separately on a mock lunar surface base supplied with the kit.

As there are in effect two separate kits, you can work on them in parallel – building, gluing or painting one, while the other is drying. After painting as many of the parts as possible on their sprues, construction begins with the launch escape tower. This can be built with its aerodynamic nose shroud open or closed. The photo on the box lid shows it in the open position.

The lattice-work of support struts that link the tower to the top of the Command Module is a bit of a fiddle to hold together until it is completely assembled. It's one of those jobs that you need a third hand for. The tower rockets are best painted before assembly – it's very awkward afterwards, because the rocket exhaust nozzles are surrounded by the support struts.

Command module

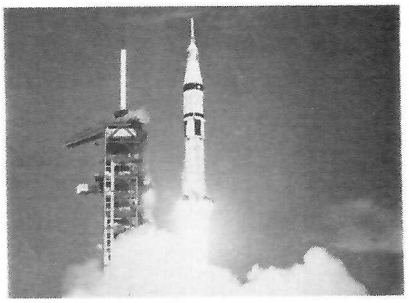
While the tower is drying, you can start on the Command Module. The floor of the module is painted medium blue, with silver trunking snaking across it. Meticulous care here is largely wasted as most of the module floor is covered or hidden from view by the time the rest of the structure is assembled. The internal structure is basically a three-sided box, with



The completed Revell Apollo Lunar Spacecraft is only one of its several display options. Photo: Ian Graham.

the fourth side open to the module hatch and the whole covered by the module's conical outer wall. The astronaut figures supplied as the Command Module crew are each in two pieces. They're fairly roughly moulded, but it's of no consequence because, like the module floor, they're only just visible through the hatch. Paint them before completing the module. It's almost impossible otherwise.

The command module windows are cut from a sheet of thin perspex supplied. The window shapes are given in the instruction sheet, so that you can lay the perspex over them and cut the correct shapes first time without any guess-work – very useful. Scrape the blue paint off the inside of the window surrounds to make sure that the windows actually stick to the plastic. The rest of the Command Module assembly is perfectly straightforward. Make sure the parachute housing (part 28) is pushed firmly down and seated evenly before cementing it in place or the nose cone will not sit evenly on top of it.



Service with a smile

The Service Module is fitted with one opening section, which reveals racks of gas tanks and canisters inside. These racks are built up and painted first and then fitted into the cylindrical Service Module. The two ends of the module have some detailed pipework which is painted in silver to contrast with the yellow background. To allow the module to be fitted on to the top of the rocket, its high gain radio aerial is moveable – folding down when inside the rocket shroud.

LEM building

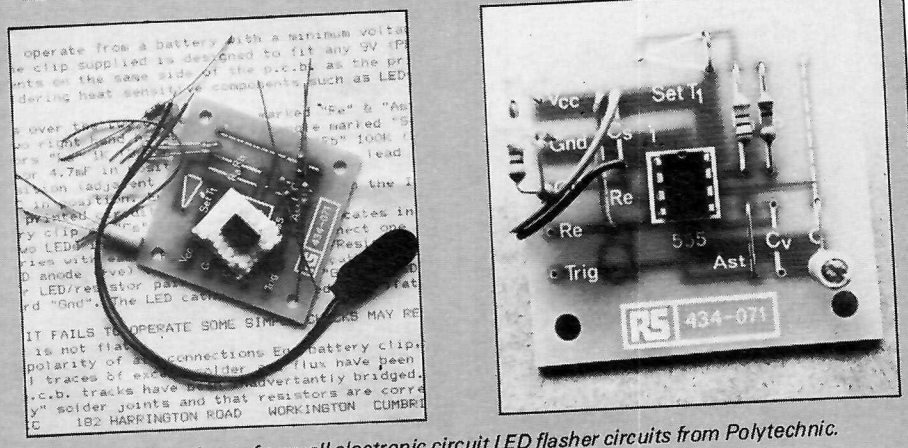
Two astronauts are provided as crew for the Lunar Excursion Module (LEM). However, I did not use them, because if they should break free from their standing position in the module after assembly, there is no way of re-positioning them inside the sealed module. Windows are fitted inside the module as for the Command Module. Once again, cutting templates are given for guidance. Quite a lot of mould flashing had to be filed away when the two halves of the LEM were cemented together.

Two assembly options are given for the descent (lower) stage of the LEM. It can either be painted silver and 'United States' decals applied, or alternatively it can be covered in

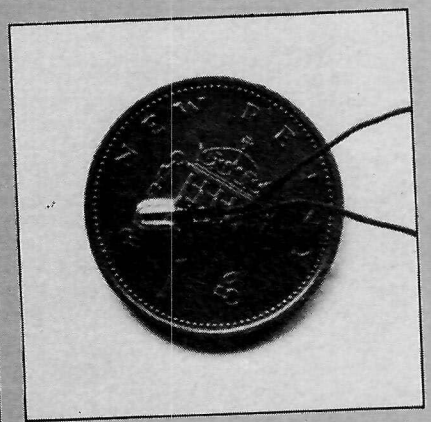
LIGHTING MODELS

A working lighting system adds that extra touch of professionalism to a model. Products aimed at meeting the particular demands of modellers who may wish to light a small model are readily available.

The most common problem is that it may not be possible to position the light source, a bulb or a Light Emitting Diode (LED), at the point where you want the light to appear. The solution is to carry the light to where it is required by optical fibre. The light source can then be mounted wherever it is convenient. A metre of half millimetre optical fibre will cost around 70-80p. If you want to produce a light spot larger than 0.5 mm in diameter, you can bunch the fibres together to make up whatever size of spot is required.



Before and after shots of a small electronic circuit LED flasher circuits from Polytechnic.



A tiny wire-ended 1.5 volt bulb suitable for modelling applications.

Torch bulbs are generally unsuitable for models because of their size and familiarity – however you disguise them, they always look much like torch bulbs. However, you can get over that by using the smallest wire ended filament bulbs available, or alternatively a LED. Various mountings and reflectors enhance their appearance.

Some years ago only red LEDs were readily available. Now, though, they can be had in yellow and green too. Wire ended filament lamps can also be supplied in a range of colours. Of course, a filter can be used to colour the white light from a bulb before passing it along an optical fibre.

If you're a bit more ambitious, you can make up a tiny LED flasher unit quite easily using a common timer chip, called a '555'.

If you've ever soldered electronic components on a circuit board before, you'll have no trouble doing this, using a kit of parts that includes everything but the battery. These flashing LEDs might be used as, say, the navigation lights of a spacecraft. For larger static models, fluorescent strip-lights can be mounted behind a mask to simulate banks of engines firing. Generally speaking, avoid lighting that generates a lot of heat. At best you'll have a melted model, at worse a fried homestead.

Check *Space Voyager* advertisers for your model lighting supplies. The optical fibre, LED and wire-ended bulb products mentioned here were all supplied by Polytechnic, 182 Harrington Road, Workington, Cumbria CA14 3UJ.

gold foil (supplied). I opted for the gold foil. To fit it, first cut a strip slightly wider (5 mm) than the depth of the LEM descent stage (part #80) and crumple it up. Then carefully uncrumple it without tearing and apply it to the descent stage. It's much easier to do this before the folding leg assembly has been added, although not impossible. Liquid poly cement will work as long as you are cementing plastic to foil. It won't work with foil to foil, ie where the strips of foil overlap. So, keep overlaps to a minimum. When the cement has dried, you can cut away any excess foil carefully with a scalpel or modelling knife.

The leg assembly faithfully reproduces the folding action of the descent stage legs. They are folded back with the feet under the body for storage inside the Saturn shroud and then extended for the lunar landing. Be very careful when touching up the legs with gold paint after assembly. Their moving joints can be immobilised very easily. Then the next time you try to move them, the joint gives way. The Saturn rocket shroud and sky/cloud base are relatively straightforward, although fitting the four barn doors of the shroud is another one of those three-handed jobs.

Display options

The Command, Service and Lunar Excursion Modules can all be fitted together, with the launch escape tower and part of the rocket on its sky/cloud base to produce the assembly shown on the box lid. Alternatively, the Command & Service, and Lunar Excursion Modules can be linked together and displayed as they would be configured during their flight to the moon. This is probably the most difficult display option because there is no base or support supplied for it. The Lunar Excursion Module can be displayed on its own, sitting on a base that simulates part of the lunar surface. You can have a lot of fun painting this base, simulating rocket burn marks and rays of different shades of dust scattered out from the motor nozzle.

Conclusions

This is an excellent model, which I thoroughly enjoyed building. It did not suffer from the confused and faulted Jupiter C assembly instructions. On the contrary, the instructions were very clear and helpful. The various display options allowed for were particularly pleasing.

Space Voyager would like to thank Jones Models (Chiswick) Ltd for supplying Revell's Apollo Lunar Spacecraft for review.

The Lunar Module is supplied with its own mock lunar surface stand. Its legs are fully articulated so that they can be displayed folded underneath with the LEM linked to the CSM as they would be on the way to the moon, or extended for a moon landing. The Lunar Module is perhaps the most satisfying part of the kit to build. Photo: Ian Graham.

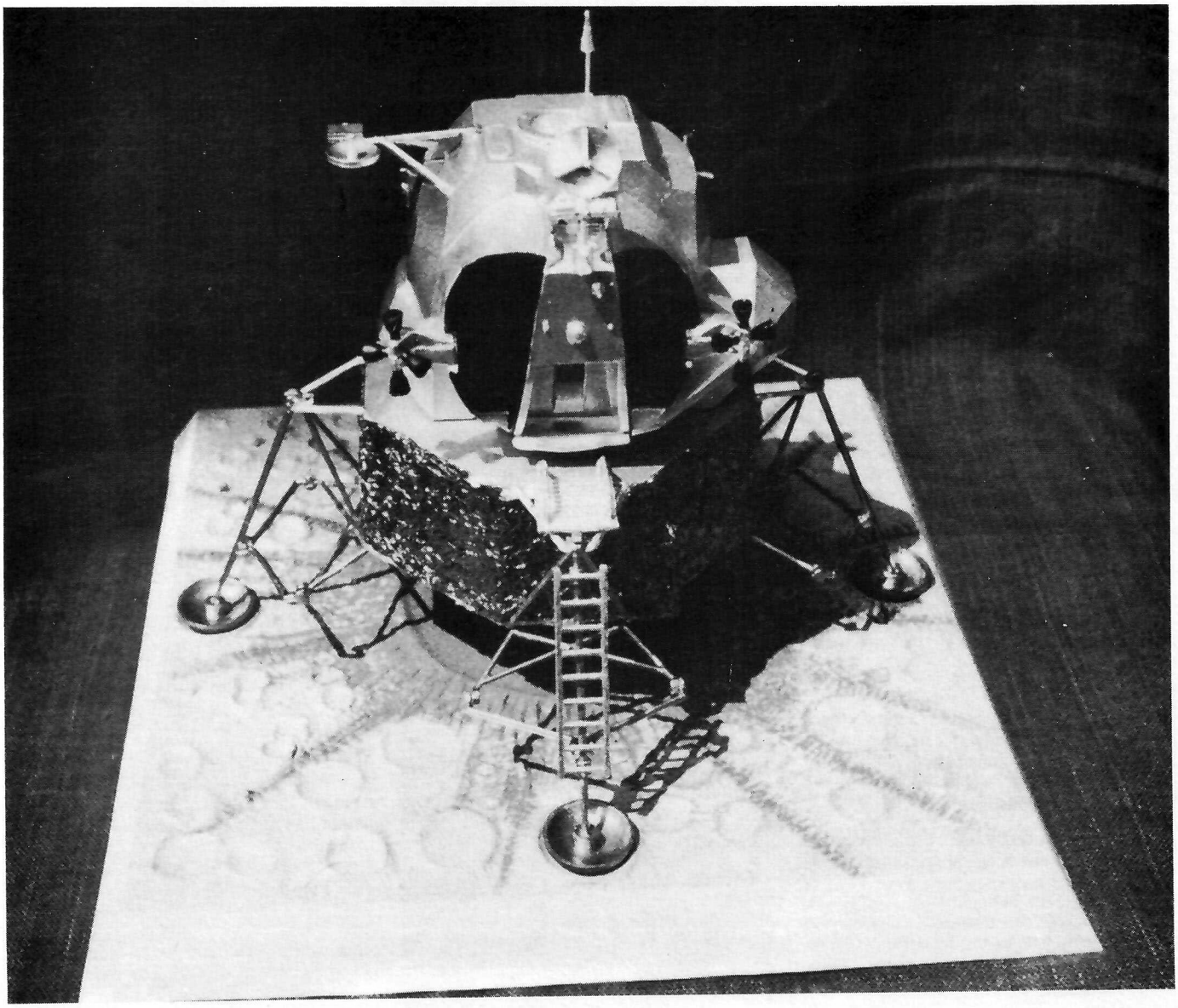


FIGURE MODELLING

WENDY INGLE OFFERS SOME PRACTICAL ADVICE ON HOW TO BUILD MODEL FIGURES. MODELS BY WENDY INGLE. PHOTOS BY TERRY HAYNES

Space figure modelling can offer a richly varied alternative to the more usual military subjects – no more muddied Tommies or strutting Hussars. Fantasy gamers too, with a little practise, can build their own unique figures as an alternative to commercial castings.

As a start, why not try a few figures from your favourite space saga? You'll still need to do some research, which, despite the many photos available, can be trickier than you might expect. You don't get many photos of backs, nor of footwear.

There is a choice of three kits you can use, unless you care to scratchbuild. If you can find them, Airfix Multipose offer a variety of action poses, or are easily cut and cemented into your chosen position. Historex are a good alternative, their spares service allowing you to select each part individually.

Both of these are in 54 mm scale, though in practice Historex work out a little larger. If you want a slightly more imposing figure try Tamiya's 1/25 scale World War II kits. These are slightly easier to detail, but also demand more detail. Finished, they stand about 70 mm.

Doctor Who conversion

Tom Baker's Doctor Who was a fairly simple conversion, involving no alteration of pose. After the uniform details were cleaned off the coat was added using lead foil. This is attached across the shoulders and below the arms, leaving coat shoulders, collar and other detail to be added in Milliput. The scarf was made on a strip of non-stick baking paper then carefully applied to the figure once the other detail was part-cured.

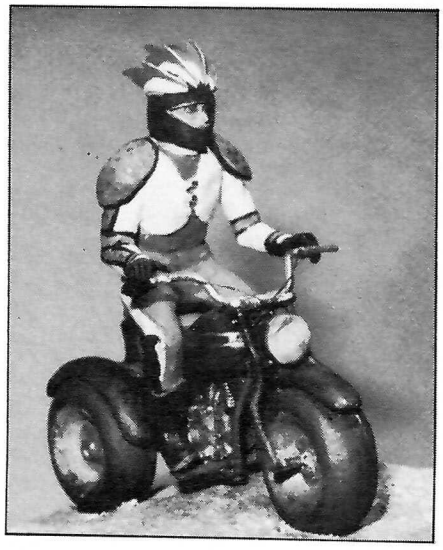
I found a picture of the Doctor in boots, which allowed me to leave them unchanged, but they could just as readily have been built up into trouser bottoms.

It is as well if building a specific character like this to try to match the face as closely as possible, if necessary transplanting a head from a different figure. Careful painting too can bring out distinctive features of the character.

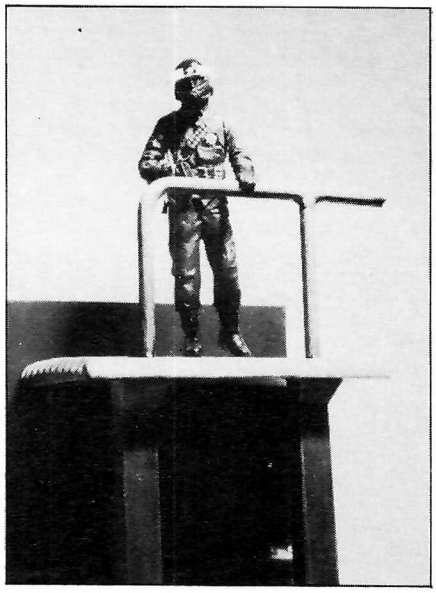
The idiosyncratic clothing of all the Doctors was (is?) equally distinctive – why not build the set?

If you intend to build them all you'll need to adjust the statures of the figures. They can be shortened best by taking out a sliver at waist and knee until the correct height is achieved. Remember, too, that posture is important. If your character stoops the model must stoop too or, no matter how accurate the other details, the model will not convince.

Tom Baker's Dr Who.



Space Rat from Blake's 7.



A Blake's 7 Federation Trooper.

Tamiya figures are made flat-headed to take a helmet. Head and hair can be built up in Milliput, but cement a knob of spare sprue on the flat surface first, to give a key for the putty. Remember when building up a head that the eyes are midway between chin and top of head. Make him too low-browed and you'll have a Neanderthal Doctor!

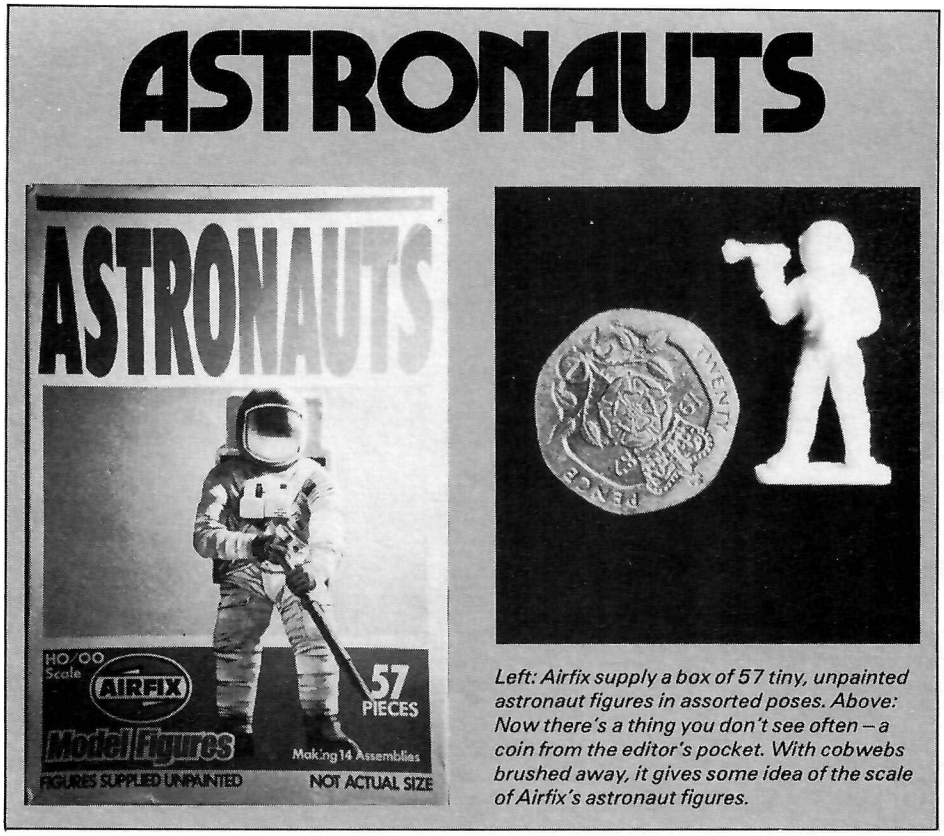
Faceless trooper

The Blake's 7 Federation Trooper is also Tamiya. The dome of his helmet is rubbed down from the original, then cemented onto a ring of clear plastic. All detail, buckles and so on, are Milliput. The gun is made up from parts of a kit gun, hollow tube from a cotton bud, cocktail stick and strips of paper.

He is a nice subject for those who, like me, don't like painting faces. His visor is painted black on the inside to enhance his anonymous menace. When painting a figure all black like this the clothing should be highlighted with a little blue-black. This is done by dry brushing – flicking an almost dry brush over the highest details.

The Space Rat (B7 again) is in two scales. While the figure is Multipose (1/32) the bike is made up from two Tamiya 1/35 scale bikes, so that it appears less than full size as were the Space Rats' little Hondas. The mudguards are from lead foil – a very useful modelling aid.

Cally's original combat suit (from 'Time



Left: Airfix supply a box of 57 tiny, unpainted astronaut figures in assorted poses. Above: Now there's a thing you don't see often – a coin from the editor's pocket. With cobwebs brushed away, it gives some idea of the scale of Airfix's astronaut figures.

The alien from Blake's 7 'Sarcophagus'. Her hair and face are washed over with thinned oriculum gold from Heritage Acrylic Paints range.

Squad') was very striking and offered the opportunity for a lot of fiddly detailing. In a case like this the basic clothing is built up first, then the detail added when the first application of putty has dried. For tiny things like the laces I allow the Milliput to dry just short of the point where it becomes unworkable. It is then very easy to roll or form into tiny details.

Her ramshackle gun is made up from about 14 separate pieces; almost as many as the BBC original I suspect. Only the grip and trigger are from a kit gun.

Myal Lemyal from 'Kill the Dead'. The tree in the background is made from a broken heather stem.

Fiddling insanity

From the realms of fantasy comes Myal Lemyal from Tanith Lee's 'Kill The Dead'. He could be almost any medieval figure but for his remarkable instrument. The author is not specific about his looks apart from his red and green sleeves, hair long enough to fall into his eyes, and the general tatteredness of him. The instrument is as I interpret the relevant passage in the book. It is cut out from plywood. The hole in the soundbox was drilled right through and then the body hollowed from behind, before a new back was added with thin card. The instrument is strung with hair. I didn't find an easy way of doing this – anyone trying it needs at least three hands and risks insanity. Very fiddly!

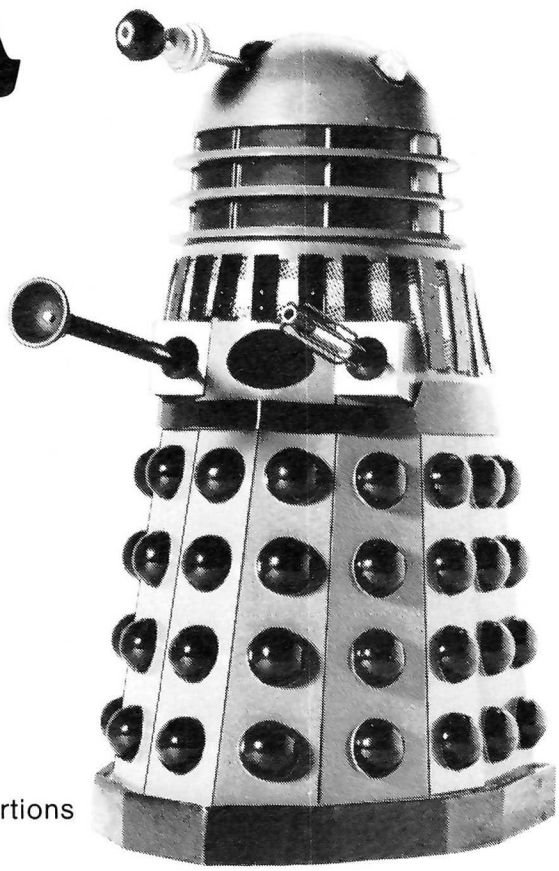
Another Tanith Lee character, Cally's alien from 'Sarcophagus', shows an example of an easily made error. Though the figure has been thoroughly finned down from a German officer, face, neck, arms, as well as body trimmed, the hands are still too big for a woman. Oh well – we live and learn!

A German helmet, suitably modified, could be the starting point for a model of Darth Vader – another nicely faceless character. Follow him up with others from *Star Wars*. Or perhaps you'd like to try a set of characters from the *Star Trek* saga, or *Galactica*, or . . .

In fact anything with distinctive clothing or weaponry offers an opportunity to the converter; even the human shaped aliens could be built up with putty. From there – your imagination is the only limit.

Cally, armed to the teeth, from 'Time Squad'.

DALEK INVASION!



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REVELL'S JUPITER C

THE JUPITER C ROCKET AND LAUNCH TOWER KIT FROM REVELL'S HISTORY MAKER SERIES BUILT AND REVIEWED BY IAN GRAHAM

In 1958, a development of the Redstone battlefield missile called the Jupiter C launcher (also called Juno 1) lifted America's first artificial satellite, Explorer 1, into Earth orbit. The first stage was a modified Redstone. The second stage comprised a cluster of 11 solid propellant rockets and the third stage a cluster of three solid propellant rockets. The fourth and final stage was a single solid propellant rocket attached to the satellite itself.

The second and third stages were rather unconventional in contemporary terms. They were in the form of two rings of solid rockets contained in a spinning barrel-like tank mounted right on top of the rocket. Before lift-off, this barrel was set spinning by a pair of electric motors to equalise the thrust from its component rockets. Stabilisation was achieved in the same way as in the second World War German V-2 – a gyro-platform controlling the movements of steerable jet vanes and aerodynamic rudders.

When the rocket and its payload were ready for launch, they would be carried to the launch pad held horizontally on the back of a railway transporter. At the pad, the service tower and rocket were raised to the vertical. Platforms at four levels around the rocket allowed technicians to make final checks and preparations. Just before launch, the service platforms split along their mid-line and rolled apart, allowing the transporter to move back and leave the rocket sitting on the pad.

Revell's Jupiter C

The rocket, rail transporter and service tower are available as a 1/110 scale model in Revell's History Makers Series II. The main structure, the transporter, is basically a box constructed from a mixture of solid walls and interlinking girder sections. Although the assembly instructions are relatively clear, some extra detail here would have been helpful in the assembly of overlapping components on the top of the transporter.

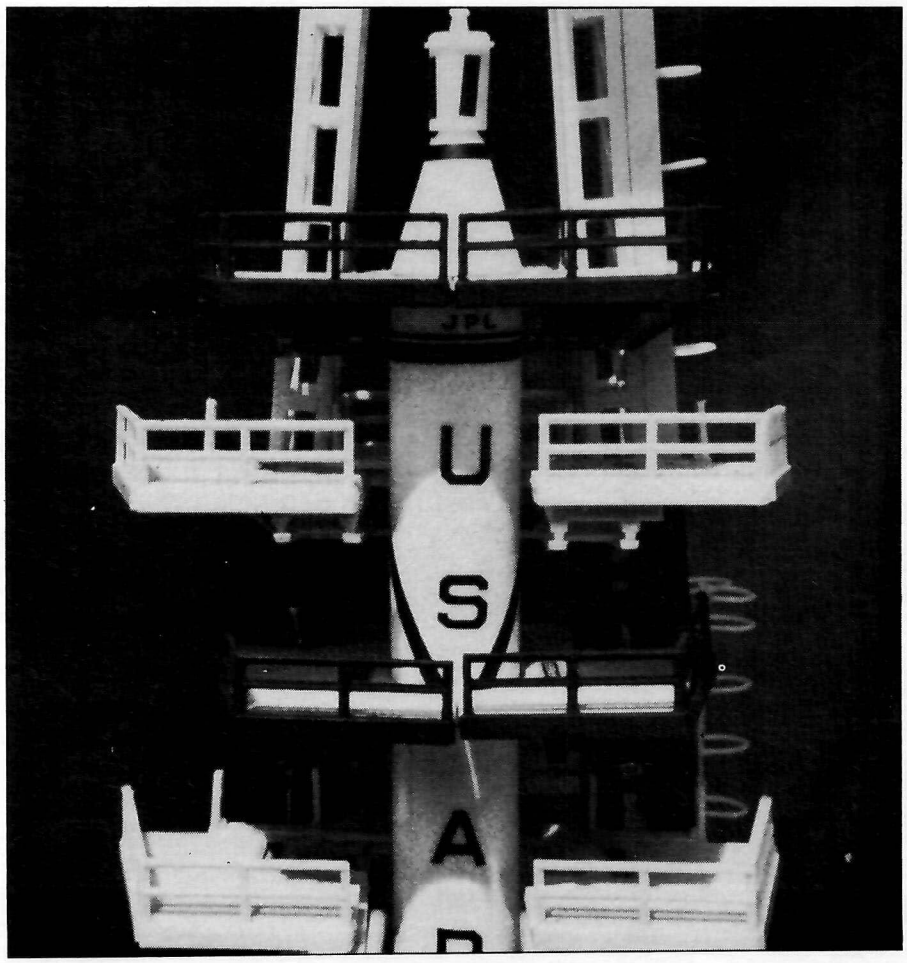
Reference to the box lid photos for extra information will not necessarily be of any assistance. The model shown in various views on the box lid is incomplete (the second and third stage rocket clusters above its nose-cone and a side rail on one of the service platforms are missing) and it is painted slightly differently from the scheme shown in the assembly instructions. Correct painting, therefore, calls for a photo of the real thing – not easy to come by.

The construction of the service platforms is also complicated by confusing instructions. Use your commonsense. When you're preparing the transporter's rail wheels for assembly, don't pare the casting lines or flashing off too enthusiastically. These wheels are simply push-fitted into the bogeys, so that the transporter will roll smoothly on the rails. If you take too much material off each end, you'll find that the wheels fall out or jump out of place at the slightest provocation! The final touch to the transporter is the addition of a few pieces of black thread to simulate steel hausers. The thread is not included in the kit, so a raid on the household sewing box is called for.

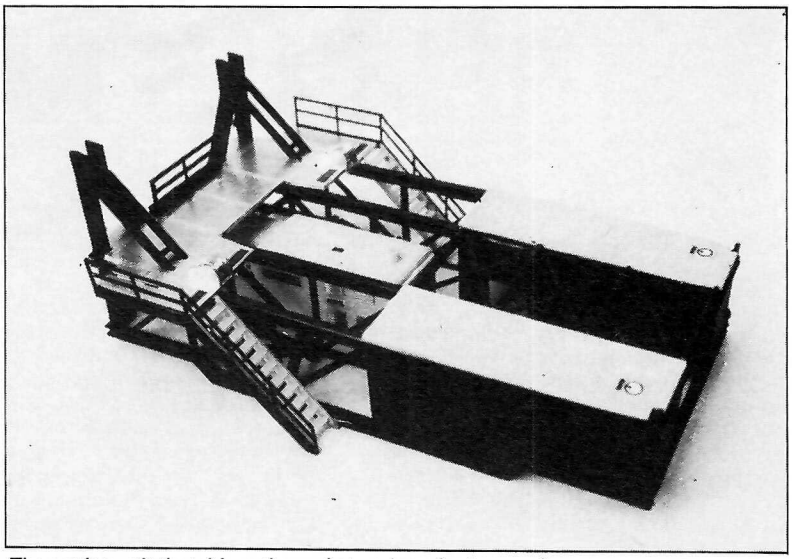
Simple rocketteering

Construction of the rocket itself couldn't be simpler. It's basically just a plastic tube with fins on one end and a cone on the other. Although it looks rather disappointingly bland, application of the decals supplied and with a couple of black panels painted between the tail fins makes it look a whole lot better.

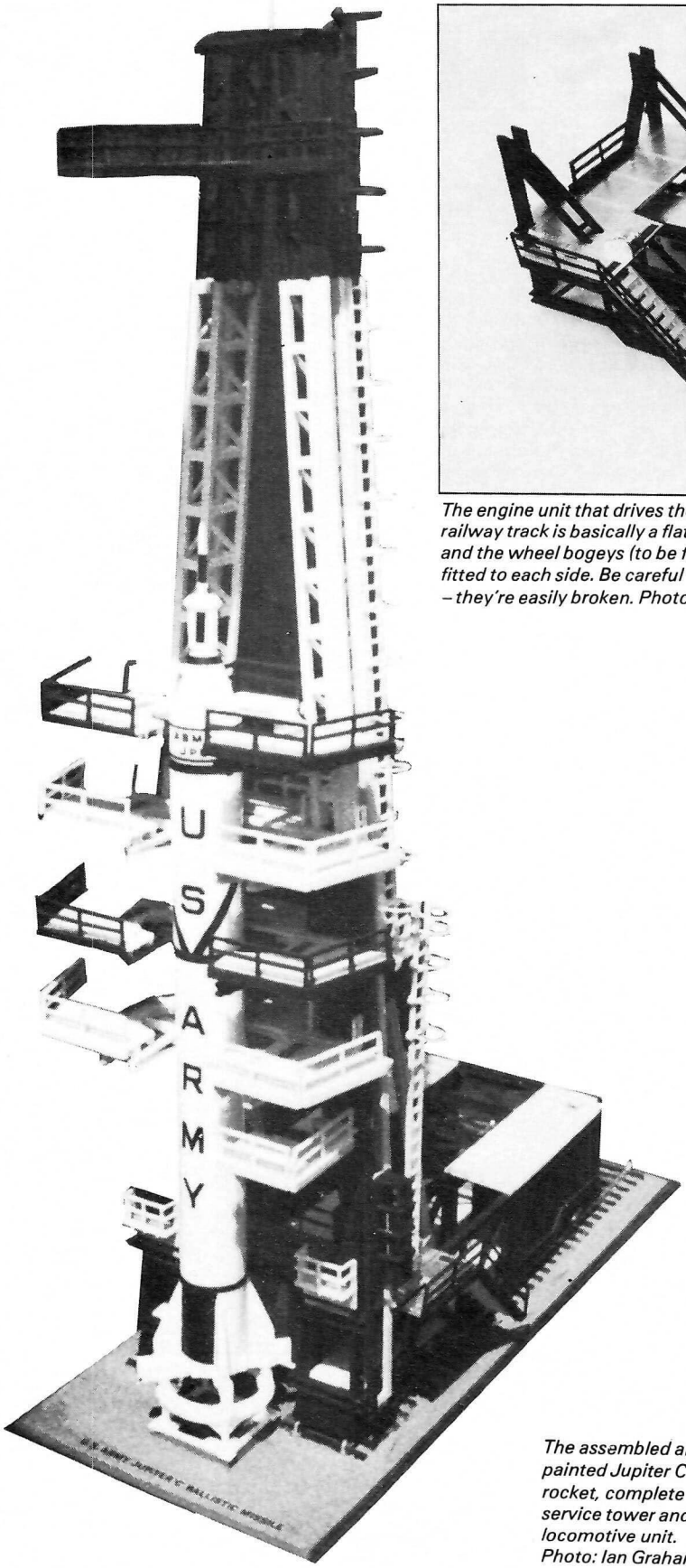
A short piece of dual railway line on a flat plastic backing is supplied for mounting the transporter. The launch pad sits at one end of the line. Painting can be tricky. The rails are painted silver, the sleepers between them



Like the tower structure itself, the service platforms are not cemented in place round the rocket. They are intended to be closed for construction and servicing, and then opened so that the engine and tower can reverse back from the rocket, leaving it sitting alone on the launch pad. The platforms are shown here alternately open and closed. Photo: Ian Graham.



The engine unit that drives the rocket and service tower along a railway track is basically a flat box. It carries the tower roots on top and the wheel bogeys (to be fitted later) underneath. A stairway is fitted to each side. Be careful when handling and fitting the stair rails – they're easily broken. Photos: Ian Graham.



The assembled and painted Jupiter C rocket, complete with service tower and locomotive unit. Photo: Ian Graham.

black and the gravel underneath them grey. However, great care here is largely wasted as the transporter covers most of the railway. The painting scheme in the assembly instructions gives no indication of what to paint the railway background, but the box lid photos show it in a matt sandy colour and that seems logical.

Seven tiny figures are supplied with the kit complete with equally tiny patches of ground on which they can stand. In fact, I did not bother using them, but you might find them useful for conveying the relative scale of the tower structure.

Cement with care

Take note of the cementing notes before making an irrevocable decision with the liquid poly. The service platforms are intended to be split and slid apart so that the transporter can be rolled back from the rocket. The tower's main support struts can be popped out of their sockets and the tower laid flat for transport. If you prefer, you can, of course, cement the whole thing into one position, but it's very satisfying to produce a 'working' model as Revell have designed it.

The solidity of the transporter coupled with the delicate lattice-work of the service tower and the 'workability' of the service platforms and tower positioning make this a very pleasing model to build. However, it is inevitably marred slightly by inadequate assembly instructions, disparities between the painting schemes on the lid photo and the assembly instructions, and an incomplete model in the lid photo. Even so, this is a model that space buffs, and in particular rocket buffs, will want to acquire.

Space Voyager would like to thank Jones Models (Chiswick) Ltd for supplying the Revell Jupiter C kit for review.

MILLENIUM FALCON

The 'Falcon' is three feet long, made of fibreglass and styrene sheet, with a tubular brass undercarriage. Detail is from about 17 tank kits and Plastruct parts. Lighting is from 10 LEDs for the cockpit, with a strip-light for the engine.

This is my first attempt at scratchbuilding, but it did raise a number of problems which many modellers must encounter.

Reference material

The scarcity and poor quality of photographs forced me to totally improvise much of the detail. No organisation or publication was able to get hold of decent pictures.

Materials

Why don't Plastruct market their whole range? Most of their best products are only available to professional modellers, but I am sure many amateurs would find them useful.

Initial construction

Modelling magazines tend to concentrate on enhancing the finished model – detailing, painting, weathering, etc – but leave out advice on building the basic shape. How about a *Space Voyager* special on how ILM build their miniatures – what materials they use, how they light their models, how they support them for filming and so on?

Plastruct replies

Ed: We felt it only fair to offer Plastruct, in the shape of EMA Model Supplies, the opportunity to comment on Mr Affuso's points.

Mr N Hands, a director of EMA Model Supplies, said, 'Believe it or not, most of our industrial range is identical to Plastruct. The only difference being that piping and fittings are supplied in up to 15 different colours and sheeting is supplied in larger sizes. Plus there are a few specialist items like labels and tools which are too specialised.

We tried, originally, to include most of the pipe fittings and valves, etc, in Plastruct, but they did not sell.

The other mundane problem is the cost and size of the EMA catalogue. He would need to charge at least £5.00 to cover cost and postage, and very few modellers would be prepared to pay this. Plus, of course, the poor retailer would be driven crazy with all the requests for different colours, etc. We will supply personal callers with any item from our EMA range.

Mail order is not possible, because some items cannot be sent through the post, ie paints, solvents, large tubing, etc. Our industrial customers have no objection to using Securicor at £7.00 a time, but imagine a hobbyist paying £7.00 to get two tins of paint!!!'

Ed: That all seems very fair and sensible to me. If you'd like to air any thoughts, or offer any advice, on model supplies, write to *Space Voyager*'s letters feature, Communications Bank (at our editorial address, given on the contents page). And if you'd like to pay EMA Model Supplies a visit to pick up one of those difficult to get items, you can find them at 58-60 The Centre, Feltham, TW13 4BH.

This impressive model of the Star Wars Millenium Falcon gives some idea of the professional results possible with scratch building. **Model and photo: Don Affuso.**

PRODUCTS

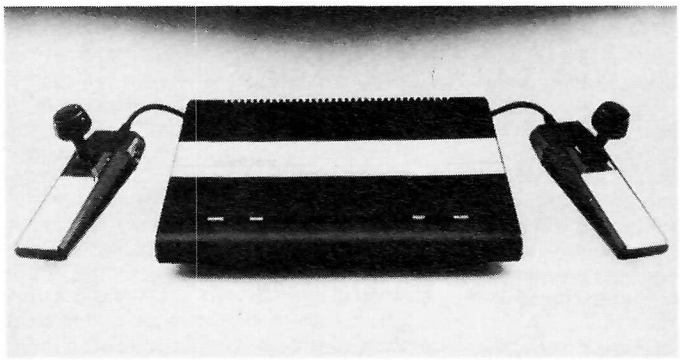
Atari-Lucasfilm link

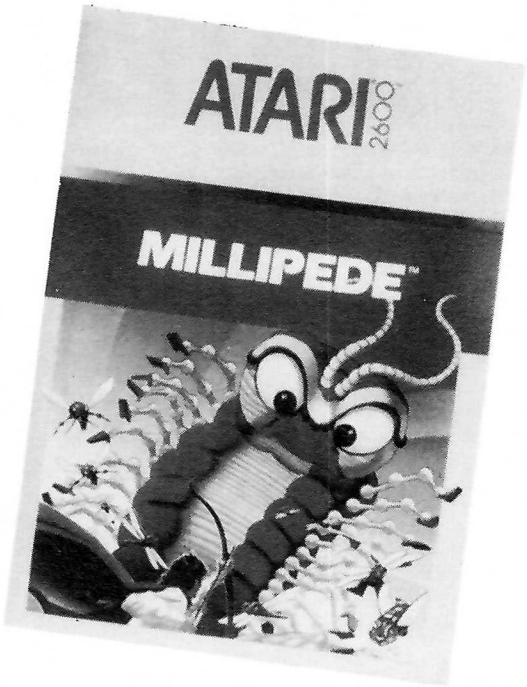
Atari International (UK) have launched two new games systems in the UK.

The Atari 7800 is described as a specialist system for the video games enthusiast seeking computer quality sound and graphics. It is available complete with new 'Super Controllers' and Pole Position II, the follow up to Atari's popular motor racing game.

Atari have got together with Lucasfilm to develop a range of innovative games featuring computer generated music and sound effects together with sophisticated three dimensional graphics. The first two to be released are Ballblazer and Rescue on Fractalus.

The 7800 should be available





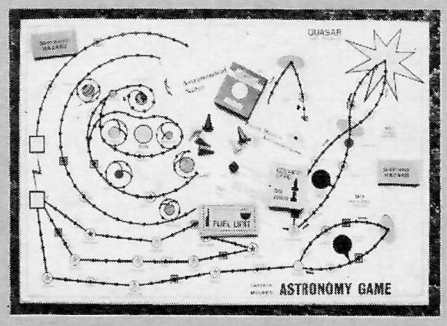
PATRICK MOORE'S ASTRONOMY GAME

A NEW BOARD GAME MAKES ITS BID FOR THE CHRISTMAS STOCKING TRADE THIS YEAR. IAN GRAHAM REVIEWS PATRICK MOORE'S ASTRONOMY GAME

To the layman astronomy is a fairly dry topic. Corona, perihelion, right ascension and Doppler Shift don't mean a great deal to the uninitiated. Experts like Patrick Moore manage to invest it with some of their own effervescent enthusiasm and excitement. Even so, it's not the leading candidate for the subject of an entertaining evening.

Well, that was my view until I unpacked a parcel that arrived at Castle Voyager one dark evening. The packaging announced that it was Patrick Moore's Astronomy Game. Inside, there were lots of interesting bits and pieces. The colourful board folds out to almost 28 by 19 inches and is overprinted by a (at first) mysterious pattern of orbits and tracks around the universe. In addition to the necessary playing tokens, dice and rules, Patrick Moore has prepared a short pamphlet entitled 'Astronomical Notes', explaining the significance of the celestial bodies featured in the game.

Essentially, the object of the game is to leave Earth with your spaceship token, progress around the courses printed on the board by throwing a dice and gain points by landing on planets and collecting samples or photographing them, before returning to Earth again. To spice things up a bit, there isn't a single path to follow, there are several. You might elect to just tour the solar system, or venture further out into the depths of interstellar space. Even then, there are three possible paths to follow. And you needn't limit yourself to only one of them.



The monster-sized board makes for more elbow room when playing, especially if the maximum of six players are trying to get round it at the same time.

Players start the game with ten fuel units. If a throw of the dice should place your spacecraft beyond an interesting feature where you can gain some points, fuel units can be given up in exchange for the ability to 'back-track' to the required point. Beware of the frequent 'H's that appear on the board. Land on one of them and you must take a hazard card. The hazard might be an engine fault or a computer error, causing a loss of fuel units or pushing the spacecraft back along its path by two or three places.

At first glance, it may seem that the player in front will snap up all the available points and clear the board. Not so. If a player overshoots a planet, he/she may not have enough fuel units to back track on every occasion. Also, once you get beyond the solar system, the leading player can only follow one path at a time, leaving the two others for following players. Once out of the solar system, there is the additional hazard of black holes. Landing on a black hole results in an instant transfer back to the solar system. Before the player can complete the course, he/she must recross to outer space and complete the journey selected to its farthest point before returning by conventional means to Earth.

The first player home isn't necessarily the winner (as I discovered!). Indeed, the player who spends most time out on the board, trying all the available courses, avoiding as many hazards as possible and cleaning up all the available points is much more likely to win.

Two to six players can play the game. The large size of the board means that all the players can get round it easily and see what's going on. The rules aren't very convoluted or difficult to grasp, so you can start playing very easily without wading through reams of instructions. Of course, that means that once you've played the game a few times, there isn't much more you can learn a about it. However, I'll wager that Patrick Moore's Astronomy Game will have more staying power than many of the flashing, beeping electronic games that will sell in their thousands this Christmas. Keep this one in mind as a gift.

Patrick Moore's Astronomy Game is available for £8.95 including post and packing from Morrison Wilpred & Co Ltd, 143 Burges Road, Thorpe Bay, Essex SS1 3JN.

this month (September '84), and you'll get a penny change from £100. Games developed exclusively for the 7800 will include Robotron: 2084, Xevious and Sphinx. The Lucasfilm titles are expected to be available in November.

The second games system is the 2600 Jr, already in the shops, retailing at £74.99, complete with Super Controllers and a Centipede game. Software for the 2600 Jr (a compact version of the ubiquitous 2600) will be compatible with the 7800.

Spaceprints calendar

Spaceprints, the UK supplier of posters, slide sets and videos, have announced the release of what has now become their annual annual calendar. The 1985 issue contains six large full colour NASA space scenes – a Voyager 1 view of Jupiter, Astronaut Schmitt on the lunar surface (Apollo 17), a composite of Voyager 1 photos of Saturn and its moons, a Viking picture of the surface of Mars, the Trifid Nebulla (M20) and the Sun's corona as seen from Skylab.

When you've finished with the pictures as a calendar, you can keep them on view by cutting off the calendar part and framing them.

Spaceprints calendar, available from September, is a very attractive 12 × 16½ inch package which retails at £3.50 inclusive of postage and packing. Spaceprints say that stocks are limited, so order as early as possible to avoid disappointment.

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EUROPE'S FUTURE IN SPACE

AS NASA PREPARES TO EMBARK ON ITS MOMENTOUS PERMANENTLY MANNED SPACE STATION PROJECT, CHARLES RADLEY WONDERS WHETHER THE EUROPEAN SPACE AGENCY OUGHT TO BE PARTICIPATING OR GOING IT ALONE IN SPACE

The European Space programme is now at a crucial crossroads, and decisions made now will determine whether Europe will join the big boys, NASA and the USSR, or will be left behind permanently. NASA is now committed to developing a space station and Europe has been invited to participate. In *Space Voyager* No 10 Andy Nimmo argued eloquently for Europe to take up this offer. But is European participation in a NASA station the best option? ESA has collaborated in several NASA programmes over the last few years and NASA has sometimes been an unreliable partner.

First was the dramatic International Solar Polar Mission (ISPM) incident. ISPM was originally intended to be a spectacular scientific mission involving two space probes – one to fly over the Sun's North pole, the other over its South pole. One spacecraft was to be provided by NASA and the other by ESA. NASA would launch both on the Space Shuttle.

However, many months after a formal Memorandum of Understanding was signed by NASA and ESA, which theoretically committed both agencies to the project, NASA

Also, before Ariane was planned, France and Germany wanted to launch Symphonie, a communications satellite, on an American launch vehicle. Before allowing the launch the US government tried to impose a condition that the satellite not be used for commercial purposes which might compete with American satellites. France was especially infuriated by this and the incident made France, the key proponent for the Ariane programme, determined to make Europe independent of the USA for satellite launchers, so that such political pressure could not be exerted again. Subsequently the United States dropped their restrictions on Symphonie, but the damage was done.

Despite the chequered history, ESA has not ruled out the idea of collaborating with NASA on their Space Station, but not unnaturally they are being very cautious. Europe already has its own proposal for a small independent station called *Columbus* and there is much to be said in favour of it. Europe anticipates about a year of hard negotiations with NASA to ensure that any European involvement would be of a fair and mutually advantageous nature, avoiding some of the mistakes made in the past.

stages (PAM-D and IUS) which do not work reliably.

The NASA shuttle is designed to carry both men and cargo at the same time, and as a result is not very economic at carrying either. ESA, by designing two vehicles, one for cargo and one for men, could undercut NASA. But time is fast slipping by and ESA must act now or the opportunity will be lost forever. The key is the shape of the Ariane launcher follow-on programme. Ariane-1, 2, and 3 are already operational. The larger Ariane-4 will be operational in 1986. However Ariane-4 will be another conventional throw-away expendable rocket, like its one-shot forbears.

Planning has now started for the future Ariane-5 version and there is hot debate on what it should look like. Many people argue that Ariane-5 should simply be another even bigger expendable rocket, since this would be relatively cheap to develop. However, they should remember that the Americans are not standing still. Although the present NASA shuttle is no cheaper than conventional expendable launchers, whatever NASA will develop to follow the Shuttle will undoubtedly be much better and much cheaper than expendables. In fact, the days of expendable vehicles are numbered and Europe should lean towards fully reusable vehicles for the Ariane-5. An unmanned fully reusable vehicle will be excellent for launching commercial payloads more cheaply than the NASA shuttle, because it will not need all the expensive and wasteful life support equipment required to look after a human crew.

However, a two-man mini-shuttle will be very useful for satellite retrieval and repair, space station servicing and resupply and rapid response rescue missions. The NASA shuttle is economically unsuitable for those roles. Despite the highly spectacular retrieval and repair of the Solar Max satellite by the Shuttle and her astronauts, in the end it was purely a technological experiment. The shuttle mission was so expensive it would probably have been cheaper to build and launch a new satellite.

However, a mini-shuttle would be cheaper and more flexible than the shuttle, and could rescue and repair satellites at a fraction of the cost of using the NASA shuttle. Studies such as Mustard in Britain (see *Space Voyager* No 10), Spacecab by David Ashford of the British Interplanetary Society and Hermes by the French space agency CNES, have all shown that reusable space vehicles are well within Europe's capability, and would be highly profitable. It may well be better for Europe to develop this new family of reusable launch

suddenly and unilaterally pulled out of the project in the face of financial pressure from the US government. ESA had already spent large sums of money on ISPM and had committed significant future resources. Despite heated negotiations, the position stood. ESA was left to continue to develop their spacecraft alone. Although the NASA spacecraft was cancelled, it was agreed that NASA would launch ESA's probe and would provide their deep space tracking facilities.

The science return from the single ISPM will be a mere shadow of what could have been achieved with two. Dr Haskell of the ESA Science Directorate said '... the ISPM programme is like a man after a serious traffic accident who has lost one leg. He is very glad to be alive, but he really would like that other leg back.'

Poor Spacelab deal

ISPM is an experience ESA will not forget for many years. Furthermore, ESA was given a poor deal from NASA in return for Spacelab. Spacelab was built at great expense by ESA and effectively handed over to NASA free of charge! In return NASA gave ESA one free Spacelab launch (Spacelab-1 on STS-9) which is scant recompense for ESA's massive investment. Worse still, NASA will charge ESA at the full rate for all future ESA Spacelab flights on the Shuttle.

Two other incidents are worthy of note. In the early 1970s Hawker Siddeley Dynamics Ltd (now part of British Aerospace) was designing a reusable Space Tug under contract to ELDO (now part of ESA), in collaboration with NASA to complement the new Space Shuttle. However the European concept was so advanced that the US State Department insisted that the work be stopped because Europe was in danger of overtaking the USA. And that was the last of Europe's Space Tug!

Gaps in the market

There are two other gaping holes in the space market which Europe would do well to fill as quickly as possible. First is a manned mini-shuttle, to complement NASA's oversized Shuttle, and second is a large unmanned fully reusable launch vehicle capable of delivering cargo to Earth orbit at a fraction of the cost of NASA's shuttle.

Despite all the glamour and trumpet blowing, the NASA Space Shuttle is not a viable economic proposition, as a result of technical compromises, and will never recoup its capital cost. The US military imposed various requirements on the vehicle which made it less than optimum for commercial operations. NASA was not funded to develop a proper space tug to complement the shuttle and now they are stuck with a family of solid fuel upper vehicles plus a small manned space station and an unmanned automated station, rather than collaborate on the NASA station.

Asteroid missions

There is another project which Europe could undertake which would be cheap, highly prestigious and very useful both from a scientific point of view and economically. Dr John Davies discussed the exploration of the asteroids in *Space Voyager* No 10. Scientists within ESA have already proposed asteroid missions, but none has won the highly competitive budget allocation process. ESA only has enough money to start one new science project every $1\frac{1}{2}$ to 2 years. Every time there are dozens of very good proposals, but the ESA science committees are dominated by astrophysicists, who usually give priority to esoteric X-ray astronomy and cosmic ray satellites, etc, which have little or no prestige value amongst the wider tax-paying public and no forseeable economic spin-off, although knowledge is said to be valuable for its own sake.

After Halley's Comet the asteroids will be the last objects in the solar system which are still totally unexplored, and it would be a marvellous coup if ESA could get there before the Americans and produce valuable new science to boot. But again Europe must act quickly because NASA is already making plans for a new family of space probes, including a mission to one or more asteroids. ESA's latest proposal is AGORA (Asteroid Gravity, Optical & Radar Analysis). An earlier one was 'Asterex'.

In conclusion it can be said that Europe lies at a crossroads, and decisions made in the next year or two will have a major effect on the long term future of Europe in space, and that means YOU!

METEORITES

SHARON CLARK INVESTIGATES THE LUMPS OF ROCK THAT REGULARLY FALL OUT OF THE SKY AND WHAT THEY HAVE TO DO WITH DINOSAURS OR THE ABSENCE OF THEM!

Throughout science fiction, the arrival of meteorites has heralded doom and destuction. In H. G Wells' classic, *The War Of The Worlds,* the arrival of a meteoritic cylinder begins the story of the near destruction of Mankind by Martian invaders. In the real world, however, their appearance is greeted with enthusiasm because these samples of extraterrestial material give us an insight into the composition of the Earth's mantle and core. A lot of effort has been devoted to identifying primative material in meteorites. Comparison of the chemistry, mineral content, structure and origin of meteorites with terrestial igneous rocks, such as basalt and granite, may eventually yield a working model for the formation of the Earth and its subsequent division into core, mantle and crust.

Meteorites can be crudely divided into two types. Firstly there are 'finds', which as the name suggests are meteorites that are found on Earth. More exciting are 'falls' which are actually seen passing through the Earth's atmosphere and then tracked to their resting places. Beyond this simple classification, meteorites are divided into stones, stony-irons and irons depending on their proportion of metal to silicate. Of all known meteorites, 61% are stones, 35% are irons and only 4% are stony-irons. Before drawing any conclusions from this it must be noted that 92% of observed falls are stones. An unfair proportion of irons are found because of their distinctive nature and appearance. Stony meteorites are easily overlooked.

Exploding falls

Falls are comparatively rare. In an average year less than ten falls are recorded although a number may be unobserved. As would be expected most falls are observed in areas of heavy population. During a fall, all that is visible from the Earth's surface is a ball of fire caused by friction between the meteorite and the Earth's atmosphere. It soon loses its planetary velocity and explodes with a loud bang. Any fragments which reach the surface will be slowed by the atmosphere to only a few hundred feet per second. Stones from one fall at Hessle in Sweden, in 1869, were seen to rebound off ice.

In a few localities, such as Arizona and Siberia, large craters are believed to have been formed by meteorites. Meteor Crater in Arizona was the first formation to be recognised as directly caused by meteorite impact. Over thirty tons of material have been collected from the area, including diamonds, coesite and shishovite, all of which can only have resulted from a violent impact to the surface. The crater is 1.3 km in diameter and it is estimated that the meteorite, called Canon Diable, was about two million tons in weight. The arid, desert climate of Arizona has helped to preserve the crater which is believed to be over 20 000 years old.

Iron meteorites often have a special structure which is revealed when a cut surface is etched by acid. These irons are called Octahedrites and are made up from two different alloys of nickel and iron, taenite and kamacite. The two alloys form a pattern of light and dark bands; a phenomenom which was first observed by W Thomson in 1804. The structure was named after a scientist called von Widmanstratten, who carried out experiments on meteorites in Vienna in 1808. Study of this structure has revealed a lot of information about the origin of meteorites.

Crystal growth

Iron meteorites are presumed to have crystallised from molten material. At a temperature greater than 800°C they would have a taenite structure. As the meteorite cools, kamacite will form in plates parallel to the planes of the eight-faced taenite crystal. The temperature at which kamacite can form is dependent on the nickel content and its rate of growth is proportional to the rate of diffusion of nickel and iron atoms in the solid alloy. As the temperature falls, the rate of diffusion slows and fails to keep up with recrystallisation. This means that the residual taenite will have nickel-poor cores and nickel-rich rims.

Microprobe studies of the residual taenite have placed meteorite cooling rates between $\frac{1}{2}$-20°C per million years. Generally, the Widmanstratten pattern keeps the same orientation over distances as great as one metre. Such large crystals are further evidence of a slow cooling rate. However, a nickel-iron body of 1 km in diameter can cool from the molten state to normal temperatures in 1000 years. This would suggest a much faster cooling rate. One explanation for this is that the meteorites were at the centre of a large mass, such as an asteroid, with a diameter of 150-400 km. The spread of cooling rates indicates irons formed in more than one body, as would be expected.

Planetary origins

Before the moon landings in 1969, meteorites were the only extraterrestial rocks available for laboratory study. To geologists and astronomers they are vital as a means of learning about the origin of the solar system. The age determination of meteorites places their origin at the same time, or immediately after, the origin of the planets. The mean abundance of the elements in chondrites, the commonest type of stony meteorite, is believed to approximate the abundance of elements in the solar system. From studying their internal structure and content of radioactive atoms and breakdown products, conclusion about the early history of meteorites and the solar system may be drawn.

There are three main theories for the origin of meteorites. The first, and the least popular, is that all meteorites are fragments of a single, disrupted planet. Evidence that meteorites formed under high pressure conditions in a body the size of the Moon, or even Mars, comes from the presence of diamond in some Canon Diablo irons. However, as mentioned earlier, the pressure required for such minerals can be produced by shock. It is also difficult to explain the cooling of such a large body in the time available. A second theory suggests that they came from two successive generations of bodies; the main objects being moon-sized pieces that collided and fragmented. The secondary bodies would be of asteroid-size which would also be broken up by collision. Most investigators prefer the theory that meteorites formed in asteroids of 100-250 km radius, which aggregated cold in the primitive solar nebula. Heat from short-lived radioactive atoms would have melted a small core in the asteroid allowing the meteorites to form. Collision with each other would break them up and eventually some would be drawn across the Earth's orbit.

Terrestrial composition

The masses of the core and the mantle of the Earth are known from geophysical measurements, but the assignment of compositions to these depends on the model used for the origin and subsequent layering of the Earth. An early estimate by H.S. Washington used a model based on a central core composed of material equivalent to iron meteorites with outer layers matching up to stony-irons and stones. Other estimates have been made taking different meteorite compositions as a base. To a geologist the information gathered from meteorites is of great value. It enables him to draw up models for the interior structure of the Earth. The major physical features of the Earth and the active belts defined by earthquakes and volcanoes are the surface expression of deep-seated processes. The greater the geologist's knowledge of the deep interior of the planet, the more he can understand and interpret what he sees on the surface.

The dinosaur's legacy

The study of meteorites has also been applied to one of the most puzzling questions facing geologists – why did dinosaurs vanish from the Earth 65 million years ago? It has been suggested that a large meteorite struck the Earth at this time, creating a sequence of catastrophic events. The evidence for this rests on the chemical analysis of strata from the end of the Cretaceous period, 65 million years ago. American geologists claim that a clay layer from this period has a chemical abundance compatible to meteoritic material rather than that of Earth. It has been postulated that a 10 km meteorite would hit the Earth with energy equivalent to a 100 million megaton bomb. Such an impact would expel vast quantities of terrestial material into the upper atmosphere, possibly blacking out the sunlight for several months. This could be responsible for the end of the dinosaur.

So it can be seen that the arrival of meteorites on Earth has opened doors into the depths of the planet's centre. They are a clue to the origin of our solar system and they may still shed light on some of the puzzles facing scientists today.

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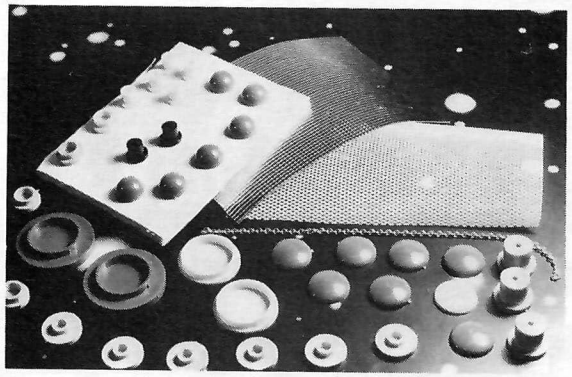

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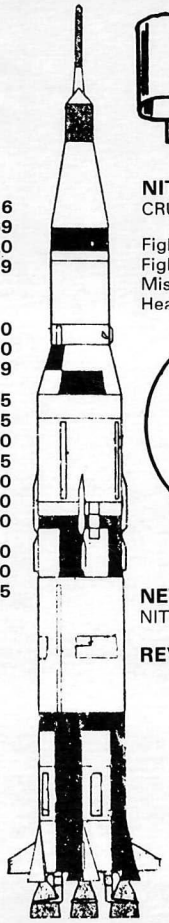

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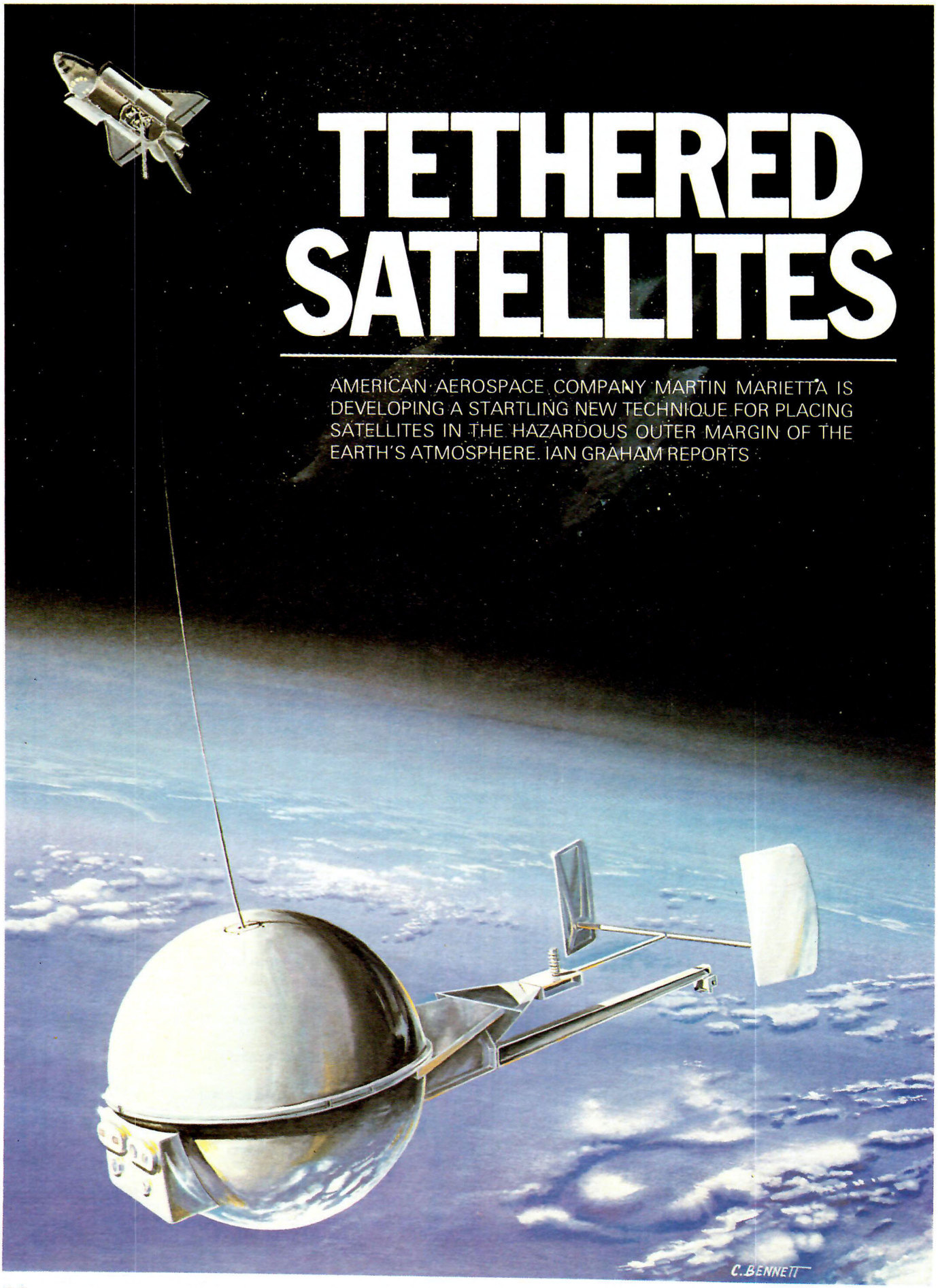


TETHERED SATELLITES

AMERICAN AEROSPACE COMPANY MARTIN MARIETTA IS DEVELOPING A STARTLING NEW TECHNIQUE FOR PLACING SATELLITES IN THE HAZARDOUS OUTER MARGIN OF THE EARTH'S ATMOSPHERE. IAN GRAHAM REPORTS

The tenuous outer fringe of the Earth's atmosphere is of great interest to space researchers, but it's a very difficult region to investigate directly. At present, only non-reusable sounding rockets can briefly visit the atmosphere/space boundary. Any satellite placed there would experience drag caused by friction with rarified gases and its orbit would begin to deteriorate. Sooner or later it would re-enter the atmosphere proper and burn up. And it's obviously undesirable to place a spacecraft like the Space Shuttle Orbiter in that hazardous orbit.

Even though the Space Shuttle itself cannot venture into such dangerous low altitude orbits, it does hold the key to future upper atmosphere studies. Current plans call for the Space Shuttle to fly a mission in December 1987 at a safe orbital altitude of about 135 miles (mission 81-E). It will launch a satellite, but not, as now, by nudging it away from the Orbiter before its own rocket module fires to place it in a higher orbit.

Even though this satellite will orbit the Earth at up to 100 kilometers away from the Orbiter, the two craft will remain connected together by a long cable or tether only 2-4 millimetres thick. When its work is done, the satellite is reeled back into the Orbiter's payload bay and returned to Earth to be prepared for its next mission. The arrangement gives rise to the system's name – Tethered Satellite System (TSS), currently under development by Martin Marietta.

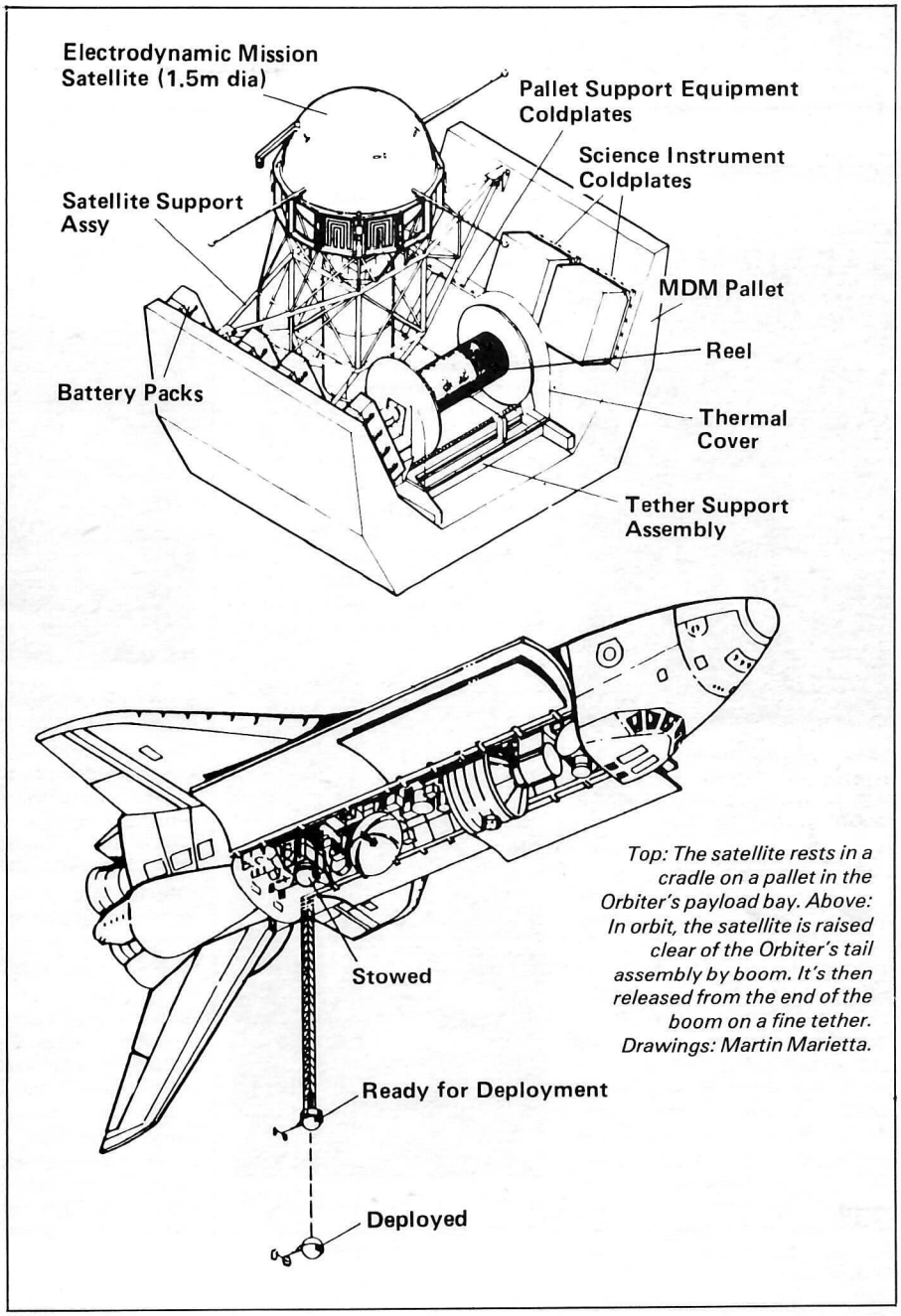
TSS applications

TSS won't simply investigate the aerodynamic characteristics of the outer atmosphere to further re-entry physics. Missions under consideration include the production of geomagnetic maps for petroleum and mineral exploration, research into earthquake prediction, high resolution photography of the Earth's surface, atmospheric studies of man-generated pollution and ozone depletion, and space plasma investigations.

Engineering applications potentially include studies of aerodynamic drag, lift, torque and heating effects on satellites and re-entry vehicles. The tether itself might be used as an aerial in very low frequency communications systems. A tethered platform well away from electromagnetic interference from the Orbiter might serve as a calibration platform for scientific instruments. With some sort of grab or tool at the end of the tether, it could be used to grapple or move craft already in orbit. A solar power or radio-isotope generator mounted on a tethered platform might provide additional electrical power for the Orbiter.

The first mission will essentially be a proving flight for the system. A satellite will be deployed upwards from the Orbiter to a distance of six to 12 miles, where it will carry out plasma physics and power generation experiments before being pulled back into the payload bay. A second mission will deploy a satellite 100 km (62 miles) below the Orbiter into the upper atmosphere. A third mission will repeat electrodynamic studies using more elaborate instrumentation. Following these three proving flights, the TSS will be declared available for operational flights by the late 1980s or early 1990s.

The tether system is jointly sponsored by NASA and the Italian Council for National Research. Martin Marietta Aerospace, under a $22 million contract to NASA's Marshall Space Flight Centre, is responsible for overall systems integration. They are currently developing the tether and control system that will be housed in the Orbiter. Aeritalia, based in Turin, will provide the first experimental tethered satellite

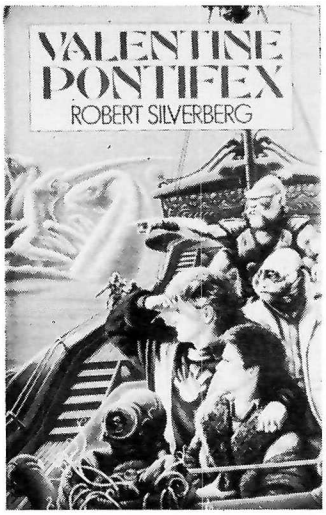


Top: The satellite rests in a cradle on a pallet in the Orbiter's payload bay. Above: In orbit, the satellite is raised clear of the Orbiter's tail assembly by boom. It's then released from the end of the boom on a fine tether. Drawings: Martin Marietta.

A satellite weighing up to 500 kg can be linked to the Orbiter by up to 100 km of tether only four millimetres thick. Photo: Martin Marietta.

READ OUT

SCIENCE FICTION



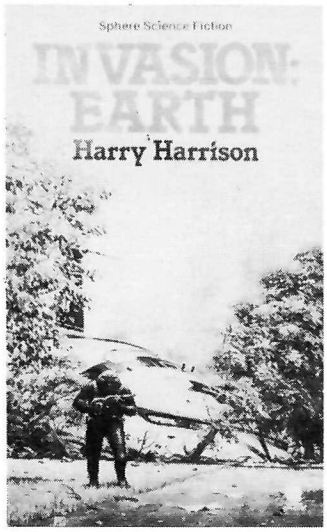
'Valentine Pontifex' by Robert Silverberg. Published by Victor Gollancz at £9.95. Hard covers.
This is the third and apparently last part of the Story of Lord Valentine of Majipoor. We first met him in *Lord Valentine's Castle* as a young man in a strange body, without memory of what he was, and now, as the title indicates, he is no longer Coronal but the supreme Ruler, the Pontifex, who reigns from the heart of the underground Labyrinth, but that is at the end of the book, and he has many adventures as he seeks to put an end to the war between his people and the Shapeshifters. It seems almost a pity that he bids farewell to us as well as his former court at the end of the book, as we have had such fun and excitement following him. Perhaps we may get more Majipoor adventures in the future, following another Lord Coronal, but do read this anyway, it is quite enthralling. **MV**

'Invasion Earth' by Harry Harrison. Published by Sphere at £1.50. Paperback.
Don't read the back cover blurb before you read the book – it gives away some of the plot! This slim volume (150 pages) details the fate of the Earth following the crashlanding of an alien spacecraft in Central Park (they never touch down on a rubbish tip in Skegness, do they?). The crashed ship has no less than two breeds of alien on board – one of them complete with a few added metal limbs.

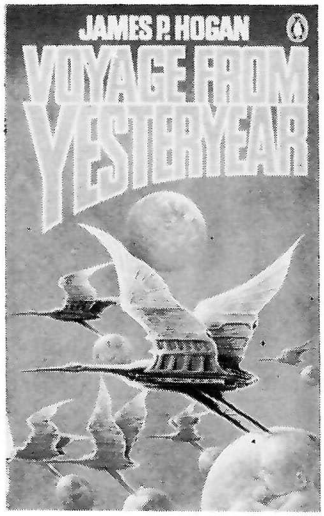
The story moves along apace with courageous soldier types mingling with the American president, a pacifist interpreter and assorted Soviet soldiers and politicians all trying to save the Earth from destruction, but destruction by who? Thereby hangs the tale!

This simple story of E.T. (them) versus the home team (us) is gradually complicated by deception and suspicion on all sides, so that no-one knows who is telling the truth. The alien's capacity for deception is substantial, because of course they have been monitoring human radio broadcasts and have learnt the two most common languages – English (well, American) and Russian.

It's a lightweight tale of global desruction, but it held my attention. I wanted to know what happened next. The characters are well-defined, perhaps because they slot into stereotypical pigeon holes. Nevertheless, they stick in your mind so that you don't have to keep going back to chapter one to re-establish them before carrying on. A short, light, enjoyable read. **IG**



'Voyage From Yesteryear' by James P Hogan. Published by Penguin at £2.50. Soft covers.
Hogan started out as a straight SF man, but here is a story of the newish colony, Chiron. Set in the Alpha Centauri system, it started with a shipload of children, served by robots, who are sent out of danger when a global war begins on Earth. After the war, Earth goes out to take back authority over the Chironians, but doesn't find it that easy. The now adult population have a totally different culture, a totally different reference point, and no apparent animosity to the new colonists who want to turn

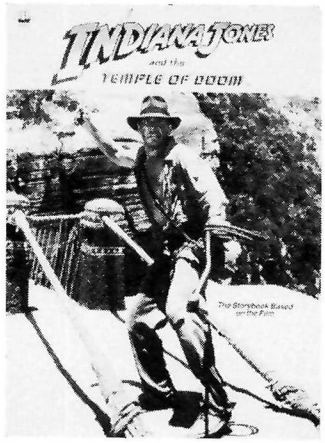


Chiron into a totalitarian state to match Earth. Will the old ideas take command, or will the new colonists/administrators succumb to new conditions? And how will you, the reader, feel about the new way of life? Basically what this book is describing is what could happen here, if enough people cared enough to start it moving, so consider that while you read this book. **MV**

'Superluminal' by Vonda N McIntyre. Published by Gollancz Books at £8.95. Hard covers.
This is a great book. Its colour and atmosphere reminds me of Delaney at his best. The author's grasp of the interlocking worlds is fantastic. Basically this novel is about faster than light travel, the ability to guide a ship through the short cuts, the other dimensions that only a few can see after special treatment and training. But we meet also the humans that have gone undersea, the Crew, who can only sleep in suspended animation through the flights between stars. And the special, restricted world of the pilots who can only travel through hyperspace by cutting themselves off from the rest of mankind until someone comes along who has the ability to travel without the training or the sacrifices. This is only Vonda McIntyre's fourth book, but in my estimation it puts her up among the greats. **MV**

'Frost' by Robin W Bailey. Published by Unwin paperbacks at £2.95. Soft covers.
Frost is wandering, cursed by her mother for killing her brother, and shorn of her sorcery, she takes to arms. But she is intercepted by a servant of the Light who begs her to take the Book of the Last Battle to safety. She does so, meeting on her way Kregan the Chondite, and Asbur the unicorn, and what a unicorn! Not the quiet, peaceful beast of legend, black, with a horn of twisted obsidian, a killer with eyes of flame. There are many dangers and battles until at last Frost can deliver her charge to the right people, and the book is exciting to the end. **MV**

'Dragon On A Pedestal' by Piers Anthony. Published by Futura Books at £2.50. Soft covers.
This is the seventh book in the Xanth series, about the land of magic that is shielded from Mundania by the Shield Stone, and remains the land of magical creatures and talents, and dreadful puns. Not all the books are to the high standard of the first, *A Spell for Chameleon*. In fact *Ogre, ogre* and *Nightmare* were quite a long way below standard, but *Dragon on a Pedestal* is way back on form. We are now at a new generation of the Royal Family, with little Ivy, who has a talent for enhancing anyone else's talent. We also meet the Magician's Humphrey's son and the Gap Dragon, rejuvenated as an extremely young dragon, and adopted by Ivy under the name of Stanley the Steamer. I thought it as much fun as the first in the series, despite the rather disappointing interrim volumes. **MV**



'Indiana Jones and the Temple of Doom' Novelisation of the film by James Kahn. Published by Sphere at £1.75, with 8 pages of colour stills. Soft covers.
'Indiana Jones and the Temple of Doom' Storybook. Adapted by Michael French. Published by

Armada at £2.95. Large format soft covers.

The first of these is meant for teenagers up, and is a straightforward novelisation of the sequel to *Raiders of the Lost Ark*. Set in India this time, it is much the same formula as before, so a lot of people are going to enjoy it. The Storybook is meant for younger children, with a shortened story in simple words and lots and lots of grossly technicolour stills. Both these books are meant for the young at heart and armchair travellers, so have fun. MV

'Thieves World' edited by Robert Asprin. Published by Penguin Books at £1.95. Soft covers.

Thieves' World is set in the small town of Sanctuary at the edge of the Empire and many people are happily writing stories against this background. Strictly Sword and Sorcery, this volume, the first, contains tales by Lynn Abbey, Marion Zimmer Bradley, John Brunner and others, but the real genius is of Robert Asprin, who got the idea of a collection of different writers handling different aspects of the same world and sold it to the writers. There are another four books out in the USA. Perhaps if you all rush out and buy this book, Penguin will publish the others (hint, hint). MV

'Earthseed' by Pamela Sargent. Published by Collins at £3.95. Soft covers.

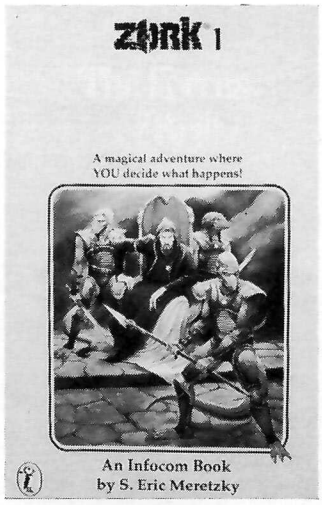
Ship is a generation spaceship, with a difference, as it carries not passengers but genetic banks. When Ship finds a suitable planet for colonisation it starts raising children to inhabit this world, but they do not want to leave the ship. In despair Ship starts giving them 'survival tests', to prepare them for outside, but the idea backfires, and a lot of nasty human traits surface. Both the children and the Ship find that they have a lot to learn, and have a hard time learning. I was quite interested in the children, but Ship was fascinating. Perhaps a sequel might be in order, please. MV

FANTASY GAME BOOKS

'Grail Quest 1. The Castle of Darkness', 'Grail Quest 2. The Den of Dragons'. Both written by J H Brennan and published by Armada at £1.50 each. Soft covers.

'Lone Wolf 1. Flight from the Dark', 'Lone Wolf 2. Fire on the Water'. Both written by Joe Dever and Gary Chalk. Published by Sparrow Books at £1.50 each. Soft covers.

Puffin started off the rage for solo dungeon books with *The Warlock of Firetop Mountain* followed by six others, and the *Sorcery!* series meant for adults, but even this fantastic rate of publishing isn't quick enough for the devotees and almost everyone is getting in on the act. The Grail Quest books are set in Avalon, with King Arthur and his court at Camelot. The Lone Wolf series is set in the world of Magnamund. Both sets are meant for children, although several adults are buying them. Basically you make a decision, then turn on through the book to find out what happens, and make a further decision, and so on. If you are careful, brave and lucky, you may survive, and even bring back treasure, but mostly at first you will be killed. The great advantage of these books is that you can try them again and again, making different decisions each time, and so having different things happen to you. I must warn you that these books are terribly addictive, for adults as well as children. All you need for the Lone Wolf series is a pencil. For the Grail Quest series you need two six-sided dice as well. Some serious fantasy gamers sneer at these, but if you have an hour or two to spare, these are ideal, as you need no other players, but do heed this warning. If you have more than one child, buy more than one book, as two players don't seem to be able to share a book without a great deal of noisy argument. MV



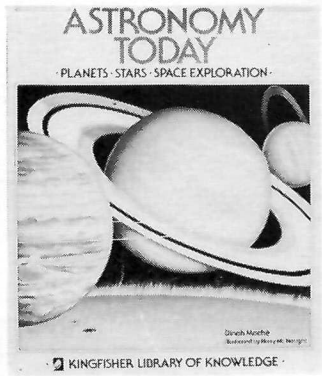
'Zork 1: The Forces of Krill', 'Zork 2: The Malifestro Quest', 'Zork 3: The Cavern of Doom' by S Eric Meretzky. Published by Puffin. Paperback.

Although these three books form a series about the land of Zork, each is self-contained, so you don't have to buy all three to complete an adventure. Every so often in the story, you are offered a decision – do you want to do this (turn to page 00), or that (turn to page 00). Your score at the end of the adventure, if you reach the end, depends on the decisions made along the way. Nice idea, because you can read the adventures over and over again, making different decisions to try to increase your score. IG

SCIENCE FACT

'Astronomy Today' by Dinah Moche, illustrated by Harry McNaught. Published by Kingfisher Books at £5.95. Hard covers.

Astronomy Today, one of Kingfisher's Library of Knowledge titles, deals with the planets and their exploration, and the stars in roughly equal proportions. This highly illustrated (in full colour) book deals with a different topic on each double page spread, starting off with the sky, the stars, the seasons and optical telescopes, then moving on to the planets. The text on each planet is accompanied by a blue data panel, giving the most important facts and figures at a glance.

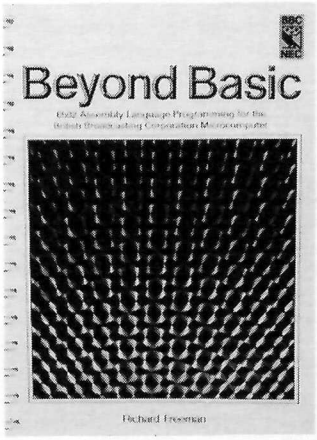


The Earth (and its moon) is dealt with in greater detail than the other planets, with spreads on continental drift, aerospace, the moon, tides, robot explorers and an Apollo mission profile.

After talking about asteroids, comets and meteors, there is a section on humans in space, including space stations and the space shuttle. Finally, the book returns to the stars, with star maps for the four seasons and more detailed information on the evolution of stars, our own galaxy, neighbouring galaxies and the origin of the universe as a whole.

The book is aimed at younger readers, who will certainly enjoy the illustrations. The subject is covered concisely and clearly with the emphasis on taking a few points and explaining them fully. Inevitably, there are many topics that could have been included but haven't been. In a book with the title *Astronomy Today,* perhaps radio, ultraviolet and infra-red astronomy should have been given rather more than a mention at the expense of some of the less relevant material on manned spaceflight. A good gift book for a young scientist, particularly with Christmas approaching over the horizon. IG

GENERAL



'Beyond BASIC' by Richard Freeman. Published by the BBC and National Extension College at £7.25. Soft covers, spiral bound.

If you've used a computer and perhaps written a few programs of

READ OUT

your own, you will be aware that the most common computer language is called BASIC (Beginner's All-purpose Symbolic Instruction Code). It is known as a high level language, because it uses words and symbols that most of us are already familiar with. The computer translates it into its own 'machine language'. Whilst BASIC is very easy to learn and use, it is too slow for some applications because it has to be translated by the computer before it can be put into action.

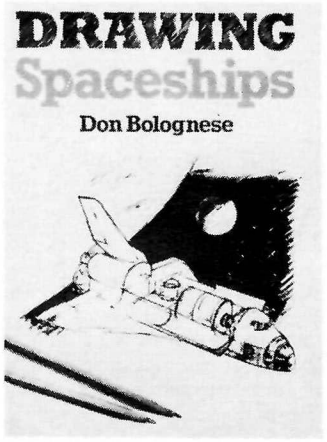
A lower level of language called Assembly Language, or simply Assembler, gives the user much more direct and intimate control over the computer. It also operates much faster than BASIC. *Beyond Basic* by Richard Freeman deals with this odd language composed of mnemonics. Because each computer uses Assembler in a slightly different way, books on Assembler are best directed at using the language on a particular computer. Richard Freeman's book deals with the BBC Micro.

It gives a good grounding in the theory and quickly offers practical examples for you to try out. It deals mainly with 'number crunching' (doing calculations) and processing lists and tables of data. You won't learn how to write all singing dancing space invader games with this book, but you can't run before you walk. If you can get through this 250-page volume, the acquired expertise will stand you in good stead when you want to move on to other books and do amazing things with sound or graphics.

This is one of the most clearly written books on Assembler that I have seen, not surprising when you see that it was published by the BBC and the National Extension College. Thoroughly recommended. IG

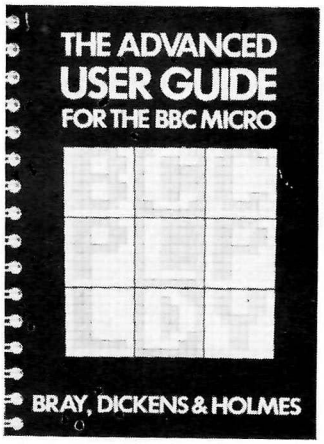
'The Harrison Ford Story' by Alan McKenzie. Published by Zomba Books at £4.95. Large format soft covers.

It seems surprising that Harrison Ford started in a very small part in a minor film in 1966 and his big break didn't come along until 1977 in *Star Wars*. Since then he has become a household name, determinedly changing roles where possible, from Vietnam war hero, to cowboy, to space pilot, to romantic lead, to wartime adventure, to college professor/roughneck. Perhaps his most interesting role was in *Bladerunner* as a detective seeking androids to destroy them. He's got a wide spectrum of fans, from young children to the middle aged. This book is a staightforward account of his life and career, with comments from himself and others and lots of black and white photographs. MV



'Drawing Spaceships' by Don Bolognese. Published by Franklin Watts at £4.95. Hard covers.

This is a book for a beginner, obviously, and explains in detail just how to get that shape, those shadings, that idea of speed. There are many sketchings and ideas for various kinds of ships, as well as suggestions for tools that can help you. This book is not only fun to read but could start anyone drawing, even me, who can only draw matchboxes to date. Watch out Bonestell, here I come! MV



'The Advanced User Guide for the BBC Micro' by Bray, Dickens & Holmes. Published by the Cambridge Microcomputer Centre at £13.95. Soft covers, spiral bound.

The User Guide supplied with the BBC Micro is excellently written, as computer manuals go. It is aimed at someone coming to the computer for the first time, possibly without any previous experience of using computers. Even so, it covers an enormous amount of ground.

However, eventually you will reach a point where you want to know a little more about the innards of the computer and what makes it tick. In particular, you may want to know how the powerful operating system is organised and what hidden secrets it contains. *The Advanced User Guide* starts where the User Guide ends.

After a short introduction to machine code for newcomers, it launches into one of the most comprehensive guides to the BBC Micro's hardware and firmware (programs permanently stored in the computer) available today. A very useful book for machine code programmers. IG

'Don't (Or How to Care For Your Computer)' by Rodnay Zaks. Published by Sybex at £10.95. Soft covers.

Computers are so commonplace in the classroom, the office and the home that it's easy to forget that they are extremely sophisticated boxes of electronics that deserve considerate treatment.

The American Sybex Corporation publishes a range of books on various aspects of microprocessors computer programming and micro applications. *Don't*, by the president of Sybex, Rodnay Zaks, is not aimed at any one make or model of computer in particular. It sets out to advise computer users on how to treat their computers properly to encourage the maximum lifespan (of the computer). Much of the material is concerned with computer installations larger than the average home set-up, but each chapter kicks off with advice aimed directly at the home micro user. It's an American book, so some sections aren't so relevant to British micro users. In particular, the electrical information (plug wiring, etc) is American.

However, there is valuable advice on how to look after the computer itself, magnetic tapes and disks, and printers. Computer documentation, security and setting up a computer room are also covered. The text is peppered with cautionary tales that one can't help but chuckle at. A little expensive, but worth a read if you are not yet confident about using computers. You'll find out just how delicate or tolerant of hostile treatment the various parts of the system are. IG

'The Complete Puzzler' compiled by Gyles Brandreth. Published by Granada at £1.50. Paperback.

Gyles Brandreth seems to have done everything – well, everything that matters in this world. He is or was an organiser of the National Scrabble Championships, founder of the British Pantomime Association, European Monopoly Champion and holder of the world record for the longest-ever after-dinner speech (11 hours!). Oh yes, and he was President of the Oxford Union and Artistic Director of the Oxford Theatre.

This compilation of puzzles, called the *Complete Puzzler*, kicks off with Mr Brandreth dispelling any idea the reader might have that he is a complete puzzler. Modest chap – in fact, he's been an enthusiastic puzzler for no less than 30 years. In a shade under 200 pages, he offers more disparate types of puzzle than I ever imagined existed – anagrams, charades, double acrostics, heiroglyphics, match puzzles, etc, etc, etc. Moreover, he gives you some idea of how difficult he thinks they are by assigning a star-rating to them – one star = easy, four stars = infuriating

There are so many puzzles of all types and levels of difficulty that there ought to be something here for everyone. IG

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MV – Marion van der Voort
IG – Ian Graham

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GETA COMPETITION

WIN A COPY OF GRANADA'S ORIGINAL PAPERBACK GETA IN OUR FREE-TO-ENTER COMPETITION

In issue no 10 Marion van der Voort reviewed a Granada paperback entitled Geta and described it as 'a marvellous story of some incredible people. I couldn't put it down.' This issue, we're offering a copy of Geta as the prize in our competition feature.

How to enter

All you have to do is answer the ten easy questions that follow (you'll find all the answers in this issue). Then, as we expect to receive lots of 100% correct entries, there is a decider to tax your creativity, originality and (we hope) sense of humour. Write all your answers clearly and send them to the competition address given here, and don't forget to enclose the entry coupon – you 'll find it at the corner of this page.

The terrible ten

1. Which video distributor released the feature film, Zardoz?
2. In 1987, what will a tethered satellite be tethered to?
3. What is Atari's latest video games system called?
4. Who is the author of the SF book, Invasion Earth?
5. Which famous comet is at this moment approaching the Earth again after an absence of 76 years?
6. Who was the first woman to make a spacewalk?
7. Which ESA satellite celebrated its first year in orbit earlier this year?
8. Which Space Shuttle mission carried the European orbiting laboratory, Spacelab?
9. What is the title of the Blake's 7 adventure to be published in book form later this year?
10. On which dates will Galacticon be held this year?

All you have to do to find the answers is read *Space Voyager* from cover to cover – which you would have done anyway, wouldn't you?

The decider

ITN and Space Services International are promoting a competition to give schools and colleges the opportunity to fly their own experiment in the Space Shuttle. It must fit inside a tiny canister fixed to one side of the payload bay. The bay as a whole is cavernous by comparison to the competition's canister. If you could have anyone you wish strapped into the Shuttle's payload bay and cut adrift in orbit (in a life support module with an everlasting supply of food, water, Space Voyagers and Star Trek video tapes, of course), who would you choose to banish to orbit, and why?

Add your choice of candidate for the space age away-day and your reason for choosing him/her in 30 words or less. Send the complete entry – answers to the terrible ten, the name of the Shuttle's extra passenger and the reason for your choice – to:

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Space Voyager
Wolsey House
Wolsey Road
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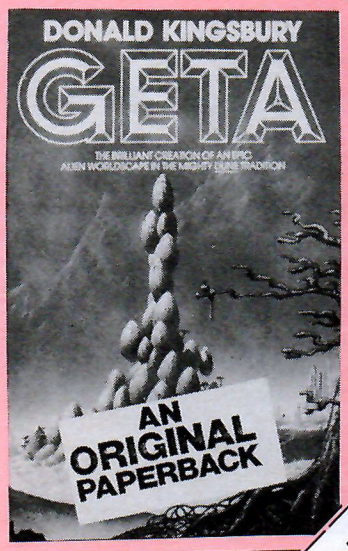
Entries to arrive no later than November 9th.

Rules

1. The competition will close on November 9th 1984. The most original entry with a correct answers to the 'terrible ten' questions will receive the prize described here.
2. Each entry must be accompanied by the entrant's name, address and the special coupon cut from this page. Each coupon covers one entry only.
3. Proof of posting will not be accepted as proof of receipt. Whilst every care will be taken, the publishers of *Space Voyager* cannot accept any responsibility for lost entries.
4. The competition is open to all residents of the United Kingdom. The staff of Argus Specialist Publications and their relatives, and *Space Voyager's* printers, advertisers and contributors are not eligible for entry.
5. The submission of a competition entry implies acceptance of these rules. The editor's decision is final and no correspondence will be entered into.



GETA CLIP COUPON

S-F ON VIDEO

MARK GORTON AND IAN GRAHAM JOIN FORCES TO REVIEW THEIR PICK OF THE SF HOME VIDEO RELEASES

One day, I suppose, in the not-too-distant future, we'll be able to turn on the holovision and watch programmes in three dimensions instead of two. For the time being, though, the good old telly will have to do. But don't despair! There are plenty of SF and fantasy films on video to help pass the time until science fiction becomes science fact.

It Came From Outer Space

We kick off with an oldie, which, funnily enough, was the first SF film to be made in 3D. Based on a screen story by Ray Bradbury, *It Came From Outer Space* (CIC Video) was released way back in 1953.

Directed by Jack Arnold, who also made the excellent *The Incredible Shrinking Man* (1957), *It Came From Outer Space* tells the story of a shipload of monstrous aliens who make Earthfall and disguise themselves as the inhabitants of a small Arizona town.

But don't be put off if this sounds like one of those alien invasion B-movies which reflect the American Cold War paranoia of the 1950s. True, decent citizens do become glassy-eyed and robotic, but for a change they are not the victims of a soulless alien power. On the contrary, the ETs are keen to return home; they simply need human form to gather materials to repair their damaged spacecraft.

They are gentle and benign – not viscious and completely without conscience like so many of their movie contemporaries – and the film ends on a happy note of cosmic friendship.

It Came From Outer Space is an eerie and optimistic movie, which will lose none of its impact on your two dimensional TV. What's more, you don't have to wear a pair of 3D specs, which would make you look as if you were from outer space. Recommended. **MG**

Zardoz

Sean Connery stars in *Zardoz*, a home video release from CBS/Fox Video. Made in1974 and photographed by the late, Oscar-winning Geoffrey Unsworth, it tells of the fate of Earth in the year 2293. The Earth has become a wasteland, thankfully not as a result of the over-used nuclear holocaust plot. A pollution disaster, now 300 years in the past, has overtaken mankind, turning the population into a seething mass of barbaric tribesmen. Only a small group of people remain unaffected, sealed off from the rest of the world in a commune called the Vortex.

A curious flying stone head, a physical manifestation of the God Zardoz, periodically visits the masses and arms a small section of them with conventional rifles and small arms. Having rededicated themselves to Zardoz, this elite force of Exterminators careers round the countryside on horseback killing other Barbarics. One of the elite Exterminators ('Z', played by Sean Connery) stows away in the sandy floor of the head, kills another being he finds there and, when the head lands at the commune, becomes the first Barbaric to breach the protective Vortex.

The Intellectuals therein are intrigued by him. Unable to die, they envy his mortality. As they're unable to die, they have no need for procreation. Z's sex drive fascinates them. Perhaps they'll keep him for breeding. Z has other ideas. The characters are rather weakly portrayed with the exception of Z, whose screen presence is greatly aided by the sheer hirsuite bulk of Connery in scanty tribal costume in contrast with the pale, thin intellectuals.

The cast includes Charlotte Rampling and Sara Kestelman as scheming Intellectuals and John Alderton as something of a rebel. But, despite such a capable cast, the story never picks up momentum and the fantasy is rather pretentious and pseudo intellectual. Try to figure out where the name of the God Zardoz came from before the plot reveals its origin. **IG**

Strange Invaders

We now come up to date with a recent film on a similar theme. *Stranger Invaders* (Thorn-EMI) posits the arrival of a scouting expedition from a distant planet with colonial ambitions, and in many ways the movie spoofs the conventions of those alien invasion films of the 1950s.

When *Strange Invaders* begins, we're 30 years in the past in an isolated town called Centreville. It's not long before some unwelcome BEMs (Bug-Eyed Monsters) drop in.

They quickly occupy the town, a base from which to explore the planet. They're sort of humanoid lizards, and to disguise their appearance they wear synthetic skins – convincing and creepy, thanks to some fine special effects.

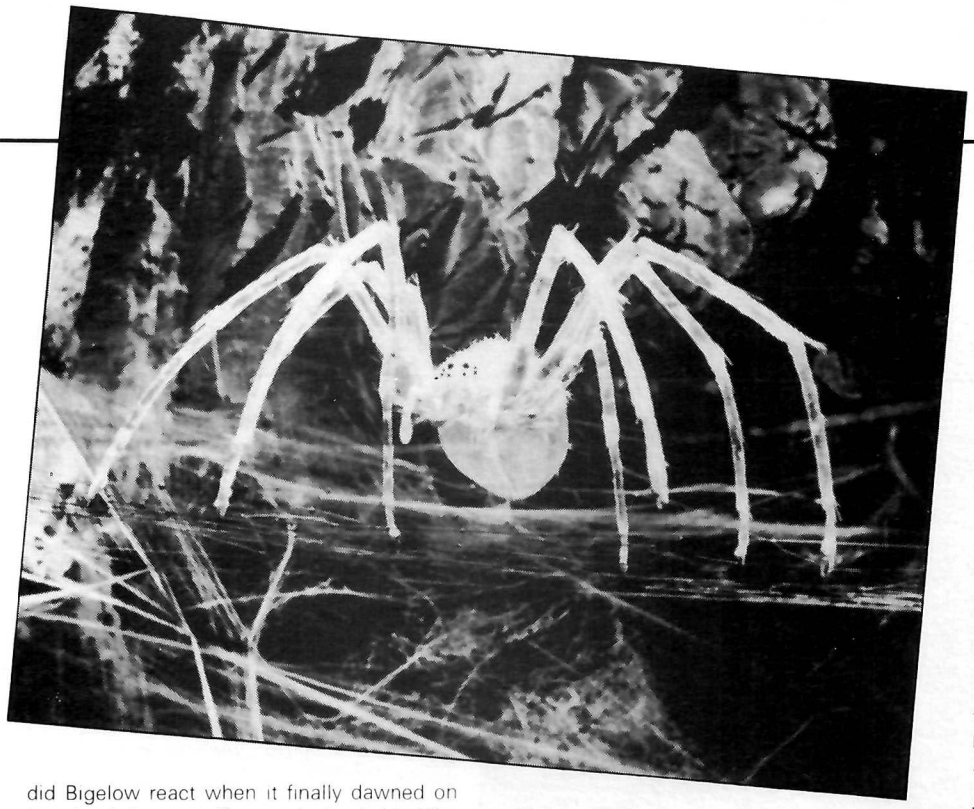
But some of the strange invaders grow too attached to Earth and its people. When the action switches to the present, we learn that one has even married the hero of the movie, an entomology professor called Charles Bigelow, and had a child too. When she says she must go to Centreville because her mother has died, and takes her daughter along, Bigelow suspects nothing . . . until it proves impossible to contact her.

He follows her to Centreville, where he quickly stumbles on the truth about its inhabitants. They now intend to return home with the results of their survey, though Bigelow's wife and child are reluctant to leave.

I won't give too much of the plot and action away, because *Strange Invaders* is a good SF film – a taut thriller with room for some neat comic touches – which I heartly recommend.

At the end, though, some questions remain unanswered. Will the aliens return in force one day? Is someone planning a sequel? And how

The Intellectuals take their revenge on Z (Sean Connery) for invading their Vortex. Photo: CBS/Fox Video



In Krull the widow who can foretell where the Black Fortress will appear is protected by the murderous spider of the impregnable web (left). Photos: © 1983 Columbia Pictures Industries Inc.

Below: Krull features Lysette Anthony as Princess Lyssa and Ken Marshall as Prince Colwyn. Photo: © 1983 Columbia Pictures Industries Inc

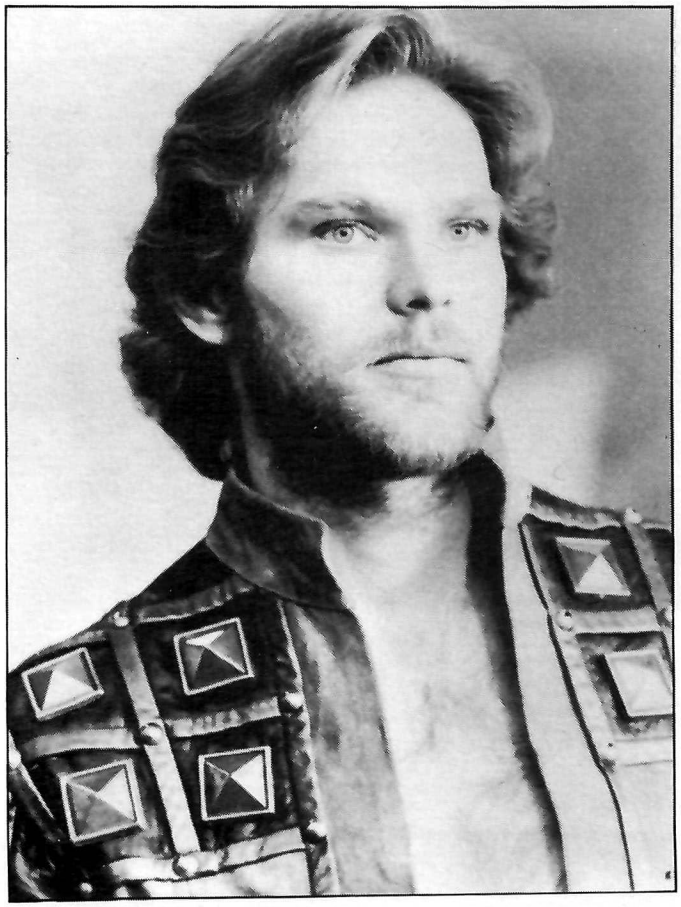
did Bigelow react when it finally dawned on him that he's married to a girl who, behind the mask, presumably has a face like the back end of an alien bus? MG

Krull

At the outset, *Krull* (From RCA/Columbia Video) is a tale of Romeo and Juliet, Montague and Capulet – two opposing houses forced into alliance by the mutual infatuation of their rebellious offspring. That in itself might be sufficiently fertile ground for an adventure – Shakespeare managed quite well with it! *Krull* uses it as but a momentary backdrop, a scene-setter for the main course. As the smitten couple approach the altar, the devilish Slayers attack and kidnap Lyssa, the bride-to-be. The Slayers are based in the Black Fortress, which has the habit of magically transporting itself to a new location at the dawn of each day.

Krull (the name of the planet where the story is set) is the tale of Colwyn's quest to rescue his fair maiden. The action is a melting pot of Princess Leia (or Lyssa in this case) in distress, a latter day Eroll Flynn (Colwyn) swashing his buckle and Jason's adventures on the Argo. The musical score is an odd admixture too, reminding me at times of *Star Wars, Lawrence of Arabia* and some indeterminate medieval theme.

Like *Raiders of the Lost Ark, Krull* evokes memories of Saturday morning matinees at the local flea pit. It's a science fiction fantasy/fairy tale for all the family. IG



S-F ON VIDEO

Left: In The Brain of Morbius (BBC Video), Tom Baker as Dr Who visits the laboratory of Solon. Photo: © BBC Enterprises.

Below: David Lightman (Matthew Broderick), demonstrates his ability to alter Jennifer's (Ally Sheedy) school grades in War Games, a United Artists film released on video by Warner Home Video.

Raiders of the Lost Ark

Harrison Ford plays the adventuring archaeologist, Indiana Jones, the perfect mixture of bespectacled academic and ready-for-anything roustabout – shades of Clark Kent/Superman. His female sidekick, Marion (played by Karen Allen) even bears a passing resemblance to Margot Kidder's Lois Lane. However, this hero's alter ego doesn't don cape and flying suit. A dusty wide-brimmed felt hat, battered jacket and a day or two's growth of beard will do nicely. His efforts to secure priceless relics for the museum are continually foiled at the last minute by the clean-cut (because he doesn't have to do any of the hard work) Belloq. The Frenchman lets Indy do the clever and risky donkey-work and then snatches the goodies from his grasp.

In *Raiders,* they cross swords in a titanic struggle for the most important relic of all time, the one and only Ark of the Covenant containing the remains of the original stone tablets carved with the ten commandments by God and given to Moses. Belloq is hired by the Nazis to bring the Ark and all the power associated with it to Hitler. Indy's services are sought by the Allies to get to the Ark first.

The story is peppered with stunts and effects. The credits include no less than 14 stunt men and women, headed by Terry Leonard. To begin with, they're Saturday matinee stunts – falls, fights, fires and crashes. Indeed the whole picture is a glorious tribute to the Saturday matinee comic strip action film. Towards the end of the film, when the mysterious powers of the Ark are revealed, the effects shift up a gear into the Star Wars league. Filmed in France, Tunisia, Hawaii and EMI Elstree, *Raiders of the Lost Ark* (CIC Video) is a thoroughly enjoyable and highly recommended adventure. **IG**

Wavelength

Wavelength (Medusa) is a movie of distinct halves. It begins well, when an out-of-luck, out-of-work musician meets a girl whose latent telepathic powers tune into alien cries for help.

The cries lead the couple to a supposedly deserted US Air Force installation, a labyrinth deep beneath the Hollywood hills. There, in cryogenic chambers, are the dimly seen bodies of four small humanoid aliens.

We're told they came down to Earth with a bump when their ship was hit by an experimental military laser. Now, dead as doornails by human standards, they are to be examined by scientists: one has even been dissected. Hence the cries for help.

So far so good. *Wavelength* is a genuinely spooky film. Then things begin to go wrong. The aliens are not dead of course, merely dormant, and now they revive. This means we have to see them, and when the hero tries a shocked look on for size and peers past the camera, saying 'They look like children!' – we know what to expect. The aliens are child actors with shaven heads. Oh dear.

Wavelength is fine, gripping even, while there's an uneasy sense of something being hidden. But as soon as the revelation takes place, and it falls flat on its face, any momentum the movie has is lost. It could really have used some of the special effects enjoyed by *Strange Invaders.*

A pity, because at first I thought *Wavelength* would notch up a much higher rating. **MG**

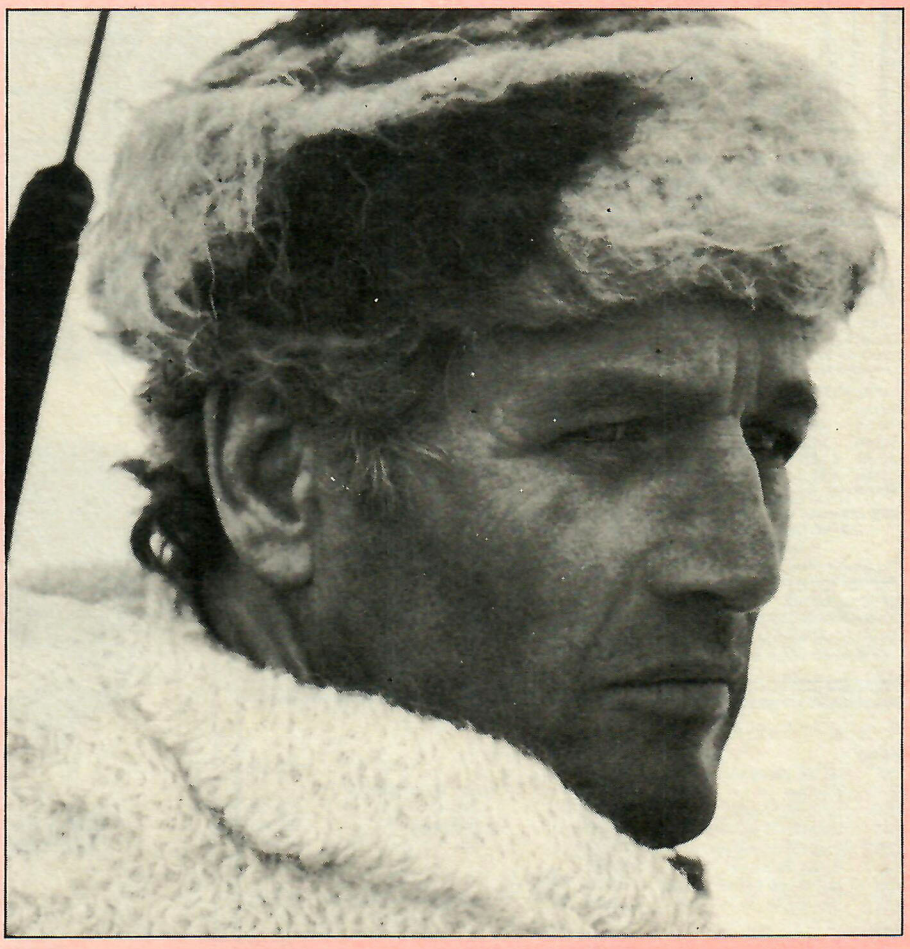
Doctor Who

Talking of family entertainment, BBC Video has released a Tom Baker Dr Who adventure called *The Brain of Morbius*. First televised way back in 1975, it stars Tom Baker with sidekick Elisabeth Sladen as Sarah Jane Smith.

The Tardis is forced to land on the planet Karn. As the Doctor shouts his protest to the four winds, a deformed simpleton roams around nearby, looking for a head. Answering to the name of Condo (although he looks the image of an Igor), he returns the fruit of his endeavours to his master, Solon, Solon, played by Philip (Lloyd George) Madoc, rejects the football-sized, insect-like head as unsuitable for his needs. What needs? Whatever he's planning, he needs a human head. Perhaps it has something to do with his perverted desire to resurrect the evil Morbius. But how? Morbius was seen to be executed on Karn.

The Doctor stumbles upon the unscrupulous scientist's laboratory. Solon immediately and ominously admires the Doctor's head. Meanwhile back at the cave, the Doctor's arrival has been sensed by a group of telepathic women, a sisterhood called the servants of the flame of life. They worship a flame which produces an elixir of life and youth. Unfortunately, the flame's yield is falling alarmingly, threatening the survival of the sisterhood.

Things don't look good for the Doctor. Not only does Solon have designs on his head, but the leader of the sisterhood has dreamt that someone would visit their planet and steal the flame of life . . . and the Doctor fits the bill. It seems odd to watch a Dr Who story without the weekly cliff-hanger ending to keep you guessing until the next episode. But the separate programmes are edited together expertly to keep the tension going. **IG**



Quintet (CBS/Fox Video) is set in the Earth's future – after the ubiquitous nuclear holocaust. A new ice age holds the planet in its grip. In a snowbound city, the inhabitants are obsessed by a board game called Quintet, whose object is to kill your opponents. One player plays the game for real. Paul Newman must identify the murderer. Quintet is produced and directed by Robert Altman. **Photo: © 1979 CBS/Fox Video.**

War Games

And finally we change theme for a word about *War Games* (Warner Home Video), one of last year's most successful films.

This cautionary tale begins when 20% of the men in America's Minuteman silos refuse to launch their weapons during a simulated attack which they believe to be the real thing. As a result, the President decides to replace human frailty with machine efficiency.

Hence WOPR – War Operation Planned Response – a super computer which does nothing but play war games, and is always ready to launch missiles without a nanosecond's moral anguish.

Human emotion is removed from the system . . . but electronic vulnerability is introduced. When High School hacker David Lightman (the excellent Matthew Broderick) tries to tap into a games company computer to pinch a little software, little does he realise that he's actually accessed NORAD's WOPR computer, which invites him to play the mega-game – Global Thermonuclear War.

Trouble is, the game is displayed on NORAD's underground screens. As far as they're concerned, the Russians are launching a nuclear attack. To make matters worse, WOPR is determined to play this game to its conclusion – the launching of retaliatory missiles and Mutually Assured Destruction (MAD). The seconds are ticking away.

Catch up with *War Games* now, if you missed it in the cinema. **MG**

THIS ISSUE'S VIDEOS

TITLE	DISTRIBUTOR
IT CAME FROM OUTER SPACE	CIC VIDEO
ZARDOZ	CBS/FOX VIDEO
STRANGE INVADERS	THORN-EMI
WAVELENGTH	MEDUSA
KRULL	RCA/COLUMBIA PICTURES VIDEO
WAR GAMES	WARNER HOME VIDEO
RAIDERS OF THE LOST ARK	CIC VIDEO
THE BRAIN OF MORBIUS	BBC VIDEO

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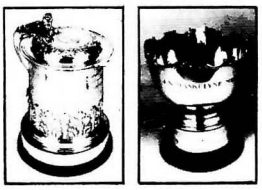

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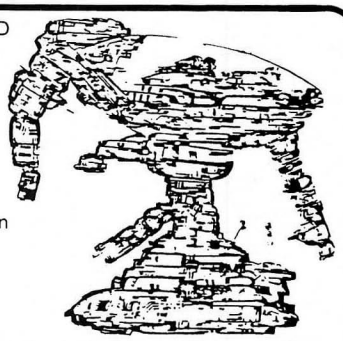

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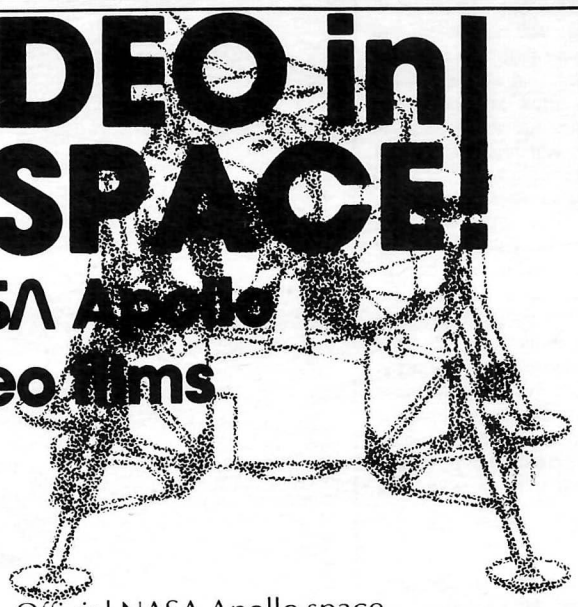

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THE OUTER PLANETS

Continued from page 41

be split into oxygen and hydrogen, and then the animals, plants and insects would have to be brought 630 million kilometres from Earth – but it would be possible, and Heinlein's book will probably be used as a textbook one day.

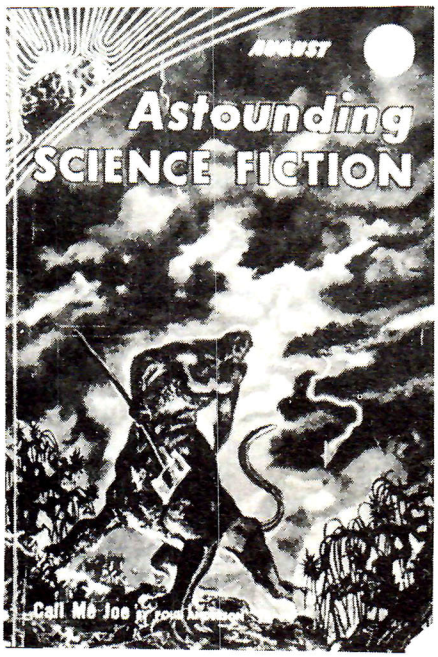
The Saturnian system

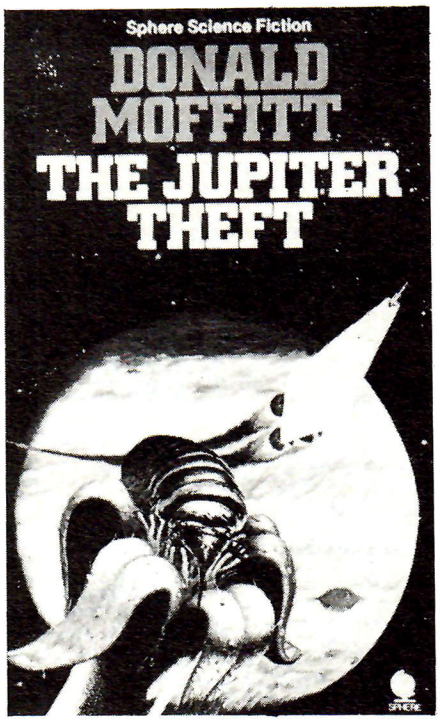
Saturn has the vast system of Rings and moons. In fact, Saturn has more satellites than even Jupiter. John Varley seems particularly fond of Saturn and writes both about the inhabitants of the Rings, many of whom have had their feet replaced by extra hands and live in combination with a symbiote that enables them to survive out there, and of a living planetoid, *Titan,* following that up with *Wizard* and soon, *Demon.* Varley is one of the new breed of writers, who seems to write neither science fiction nor fantasy, but perhaps science fantasy

Arthur C Clarke, in *2010* describes Europa, a half-frozen waste that yet supports semi-intelligent life. The race of ultra-civilised beings who assisted Man in *2001* decide to assist the Europans and do so by turning Jupiter into a miniature Sun. Incidentally, we are told by Clarke that the core of Jupiter is an Earth-sized diamond, formed from carbon sifting down from the higher atmosphere and solidifying under heat and pressure – now there's an idea!

Arthur C Clarke, in *Imperial Earth* describes the human colony on Titan, living underground while they try to turn the moon into a suitable place for humans.

But these places are so far away. We think that there may be another planet out there, as Neptune and Pluto both have disturbed orbits, and even a very dim sun has been suggested, but we will have to send many more probes out to check. We are far enough away from the Sun that its light takes eight minutes to reach us. Mars is 12 minutes away, but Jupiter doesn't





receive the light for nearly three quarters of an hour, and Pluto would take nearly six hours to notice if anything happened to the Sun. We look back on the books of the 1950s, and find that Blish and Simak were wrong, Heinlein right. In *2010* we can look back on Arthur C Clarke's book of that title, and maybe by then we will know more.

We suspect a belt of comets at the edge of the Solar System. Some get pulled in occasionally, some follow elliptical orbits, and we think that most of these consist of ice and frozen gases, but it will be a very long time before we get out there to see, or so we think today. A man of 90 today will remember the days before heavier-than-air flight. By the time that you, the reader, reach that age we might have progressed more than we can ever imagine today, but even a full exploration of our entire Solar System will not tell us that much. Look at your hand for a moment. You probably have four fingers and a separate thumb, but no matter how long you take examining your hand, it will not tell you that much, until you compare it with other hands. Maybe you are the odd one, and everyone else has two thumbs, and so our solar system may be unique. We already think that we have found planets, very large ones known as super jovians around other stars, but in many cases these are two or three star systems. It may be that life in a one star system is rare, but we do not know. That is where science fiction helps, as it draws conclusions from the facts that we know at the time.

And finally

One other thing, asked me by a reader (and thank you for reading me). John Norman has written many books about Gor, or Counter-Earth, supposedly directly opposite Earth across the Sun, so we could never see it. We wouldn't have to see it to know that it was there, as it would affect the orbits of Mars and Venus, so the Gor books, by the criterion we started with, are fantasy, and not science fiction at all.

NEXT ISSUE

THE VOLCANOS OF VENUS
Patrick Moore scrutinises the Lovers' planet and brings us up to date on the latest discoveries

THE PIPS
Greenwich Mean Time might just mean the time signal to you, but for the last hundred years it has been 0 Longitude to the world

TIME TRAVEL TIMES
We talk to former Doctor Who, Peter Davison, plus wife Sandra Dickinson, and celebrate the programme's coming of age with a preview of the forthcoming season

SHOCK WAVE ASTRONOMY
Futures consultant Andrew Nimmo discusses a new theory on the formation of the Solar System

20 YEARS ON
It's 20 years since the first few feet of film went through the camera to bring us *Star Trek.* We talk to creator Gene Roddenberry and writer David Gerrold

PITTING YOUR WITS
We take a look at some of the adventure games and educational programs around for home computers in the first of a regular series

SEZ LES
Les Dawson is best known as a lugubrious comedian, but he's also interested in the same things as *Space Voyager* readers. And since he writes in a style all his own, we've asked him to pen a few words

AND MORE
Your letters in Communications Bank and a comprehensive news section

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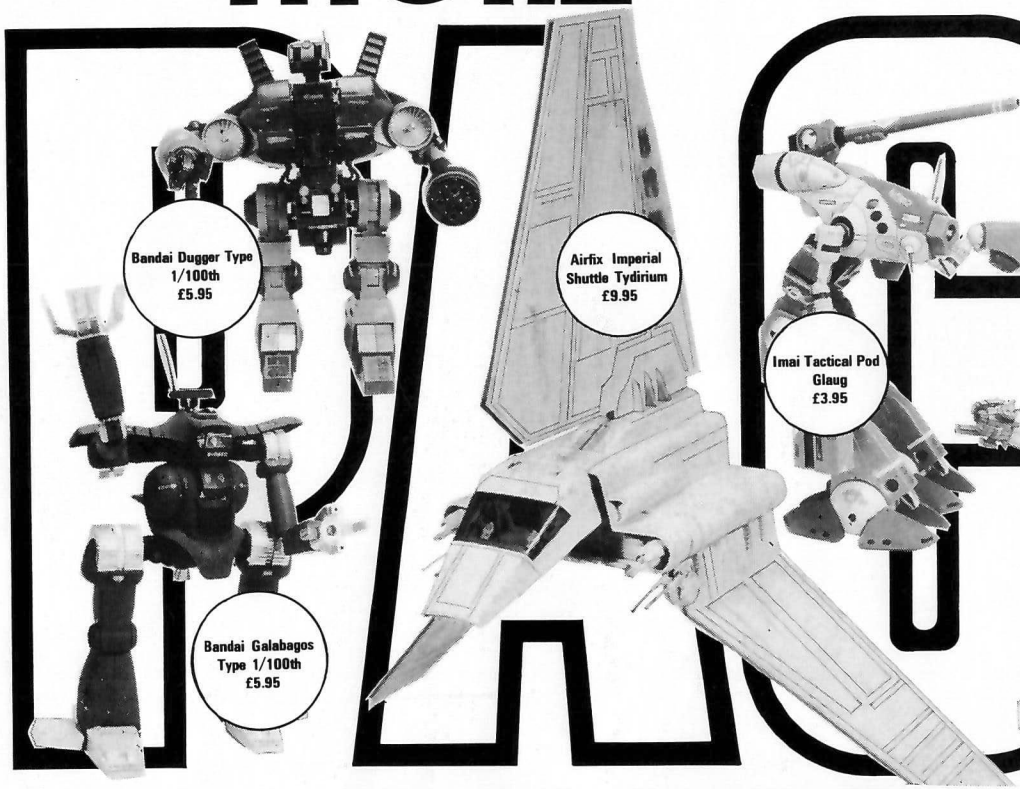

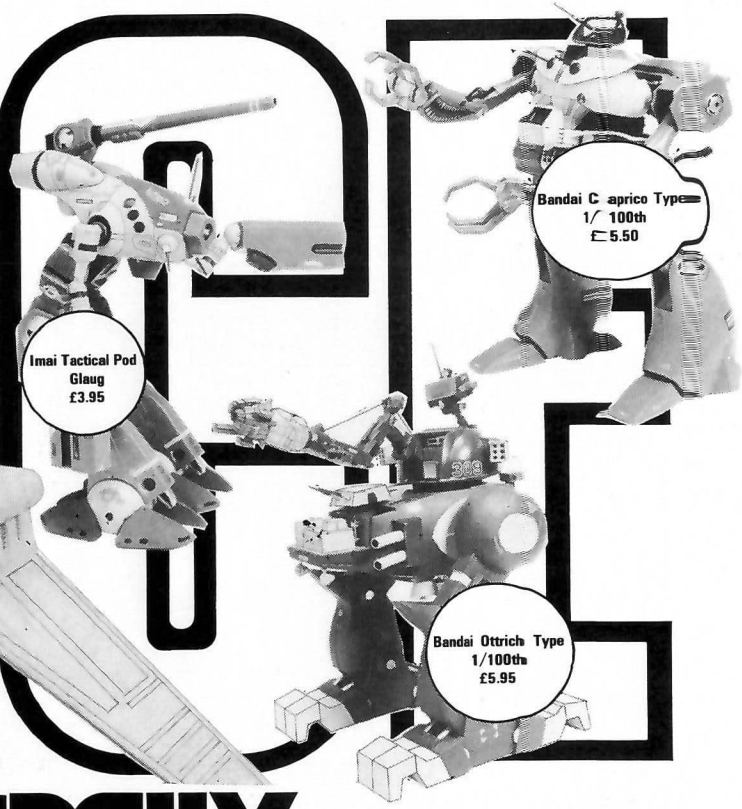

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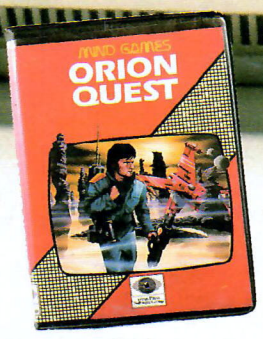

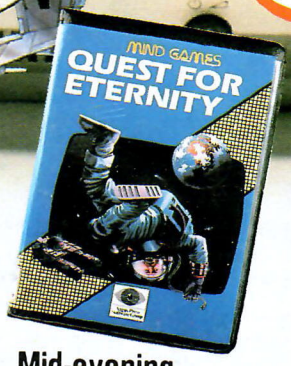

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